Program of Studies
Elementary Schools

Mathematics

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MATHEMATICS

A. PROGRAM OVERVIEW

RATIONALE

Mathematics is a common and essential human activity. To buy groceries, plan a trip, or carry out countless other everyday tasks, people need mathematics to understand the world and function in it. When students learn mathematics, they have knowledge, skills and attitudes to make decisions in daily life.

Mathematics learning is an integrated process in which students develop and demonstrate understanding by solving problems.

Students develop mathematical understanding by building on a solid foundation of previous learnings and derive meaning from suitable problem-solving experiences in the environment.

As students solve problems, they use manipulatives and diagrams to develop their understanding of concepts and make the connection with associated spoken terms and written symbols.

Students demonstrate mathematical understanding by applying their knowledge to solve real-life problems, to justify solutions, and to verify for correctness.

As students apply the knowledge learned they demonstrate their understanding of spoken terms and written symbols by using manipulatives and diagrams.

As students acquire an understanding of mathematical concepts, they further demonstrate:

- a willingness to take risks and accept challenges
- a sense of accomplishment
- a positive attitude toward mathematics learning.

PHILOSOPHY

The mathematics program of studies is built upon the following principles.

- **Students learn mathematics and apply it by solving real-life problems.**

  Students learn a new concept by solving problems that contain key aspects of the concept. They are then able to apply their understanding to new problem situations.

- **Communication is essential for developing and demonstrating conceptual understanding.**

  Students understand mathematics when they reflect upon, explain and defend their ideas, using manipulatives (concrete mode), diagrams (pictorial mode) and spoken terms and written symbols (symbolic mode).

- **Reasoning is required for understanding mathematics.**

  Students reason when they analyze situations, make choices, draw conclusions and justify processes as they work toward solutions.

- **Making connections is required for understanding mathematics.**

  Students understand mathematics by making connections with, between or among:
  - what they already know and new learning
  - mathematics and real-life problems
  - concrete, pictorial and/or symbolic modes of representation
  - conceptual understanding and procedural knowledge
  - the various strands in mathematics
  - mathematics and other subject areas.

- **Integrating assessment with instruction is necessary to maximize the progress of each student.**

  Assessing for conceptual understanding, using a variety of strategies, facilitates learning when instructional decisions can be built upon what students already know and can do.

- **Technology is changing mathematics learning.**

  Students are able to solve a wide variety of problems and focus attention upon mathematics understanding when there is appropriate use of calculators and computers.

PROBLEM SOLVING

The primary thrust of the program of studies is on developing and increasing problem-solving confidence and competence. Students need to learn many different skills and strategies to apply in a variety of old and new situations. Also, they need to express a desire to solve problems and demonstrate perseverance in carrying out solutions.

Problem solving applies mathematics to real-life situations, as well as to problems arising from the investigation of mathematical ideas. When solving problems, students must choose appropriate operations and calculation methods; e.g., estimation, mental calculation, paper and pencil, calculator. Some problems, however, cannot be solved by simply adding, subtracting, multiplying or dividing. They may require the use of other strategies, such as role playing, drawing a diagram, using a pattern or collecting data.

Students develop and demonstrate their understanding of concepts as they solve problems and apply the associated skills, strategies and attitudes within and across strands.

As students learn and apply mathematics, they focus on four integrated aspects of problem solving:

- learning about how to solve problems, by:
  - understanding the problem
  - developing and carrying out a plan
  - looking back
- learning concepts through problem solving, by:
  - beginning with a problem that contains key aspects of the concept
  - connecting the concrete with the abstract
- applying the concepts learned to new problem situations
- creating problems that exemplify the concepts learned.

PROGRAM ORGANIZATION

The program of studies provides learner expectations for each grade level from Pre-grade 1 to Grade 6.

The general learner expectations, which provide an overview, are described in greater detail through related specific learner expectations. Students achieve these expectations by solving problems related to the concepts in each of five strands.

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Strands

For clarity, the mathematics program has been described in strands. However, in practice, these strands should be integrated during instruction, learning and assessment. The strands are:

- numeration
- operations and properties
- measurement
- geometry
- data management.

Numeration

As they solve problems, students develop and demonstrate understanding of patterns, numbers and place value (whole numbers, fractions, decimals); number relationships (comparing, ordering, rounding); and estimation of quantity.

Numeration concepts form the foundation for all the other strands.

Operations and Properties

As they solve problems, students develop and demonstrate understanding of addition, subtraction, multiplication and division of whole numbers and decimals. A variety of methods can be used to solve problems; including estimating, mental calculation, algorithms; and the use of calculators or computers, with a lesser emphasis on paper and pencil calculations.

A solid knowledge of number facts is essential for developing number sense and estimation skills. Competence in a variety of estimation strategies enables students to determine the reasonableness of answers obtained, including those from calculators and computers.

To enhance their understanding of operations and mental calculations, students use the commutative, associative and distributive properties and the unique effect of 0 and 1.

Measurement

As they solve problems, students develop and demonstrate understanding of time, length, capacity, mass, temperature, money, perimeter, area, volume and angles. The emphasis is on estimating before measuring. When students estimate and then measure to check how close their estimate is, they deepen their understanding of the measurement process.

The successive stages in the measuring process include:

- making comparisons between objects
- comparing an object with a nonstandard unit
- comparing an object with a standard unit
- choosing measurement units for specific tasks.

Geometry

As they solve problems, students develop and demonstrate their understanding of the attributes of geometric shapes and spatial relationships. Building on their intuitive understanding of concepts, students move from the concrete to the abstract. They study three-dimensional objects and two-dimensional figures by moving, sorting, classifying, constructing and describing them. The emphasis is on making connections between three-dimensional objects and two-dimensional figures.

Data Management

As they solve problems, students develop and demonstrate understanding of probability and statistics, including graphing. They explore the concepts of chance through probability experiments; and in statistics, they collect, organize, display and interpret data to solve problems.

SPECIFIC LEARNER EXPECTATIONS

The specific learner expectations, in each of the five strands and across the grade levels, further expand the mathematical understandings expressed in the general learner expectations.

B. LEARNER EXPECTATIONS

PROBLEM SOLVING: Integral to All Mathematics

As students progress through the grade levels, they are challenged by problems that reflect the increasing complexity of the knowledge and skills within and across the strands.

Problem-solving strategies and skills for all grade levels are described in the following chart.

General Learner Expectations	Related Specific Learner Expectations	Grade Level						
		P	1	2	3	4	5	6
The student uses a variety of strategies to solve problems and justify the solution process. The problems integrate concepts across the strands.	**Demonstrating Traits of a Successful Problem Solver**							
	The student:							
	• demonstrates willingness to find a solution to the problem	→	→	→	→	→	→	→
	• perseveres in finding a solution to the problem	→	→	→	→	→	→	→
	• demonstrates flexibility in finding solutions to problems		→	→	→	→	→	→
	• presents ideas in an understandable way	→	→	→	→	→	→	→
	• works both individually and in a group.	→	→	→	→	→	→	→
	Understanding the Problem							
	The student:							
	• interprets pictures and diagrams	→	→	→	→	→	→	→
	• understands words and phrases	→	→	→	→	→	→	→
	• understands the question asked	→	→	→	→	→	→	→
	• identifies given information	→	→	→	→	→	→	→
	• understands what information is implied			→	→	→	→	→
	• understands what information is missing					→	→	→
	• understands what information is extraneous					→	→	→
	• restates the problem in own words.				→	→	→	→
	Developing and Carrying Out a Plan							
	The student:							
	• uses the process of elimination (logical reasoning)	→	→	→	→	→	→	→
	• uses role playing	→	→	→	→	→	→	→

General Learner Expectations	Related Specific Learner Expectations	P	1	2	3	4	5	6
	• uses manipulatives and trial and error techniques	→	→	→	→	→	→	→
	• looks for and continues patterns	→	→	→	→	→	→	→
	• draws pictures and diagrams	→	→	→	→	→	→	→
	• collects and uses data	→	→	→	→	→	→	→
	• chooses and carries out an appropriate operation, using an appropriate method			→	→	→	→	→
	• does a simpler but related problem			→	→	→	→	→
	• uses estimation, guesses and checks				→	→	→	→
	• uses tables or lists				→	→	→	→
	• works backward					→	→	→
	• monitors the process in carrying out the plan.				→	→	→	→
	Looking Back							
	The student:							
	• states the answer(s) to the problem	→	→	→	→	→	→	→
	• determines if the answer is reasonable	→	→	→	→	→	→	→
	• discusses the solution process with others		→	→	→	→	→	→
	• retells the problem with the solution			→	→	→	→	→
	• looks for other ways to solve the problem			→	→	→	→	→
	• does similar problems				→	→	→	→
	• alters the problem and finds the effect				→	→	→	→
	• generalizes the solution				→	→	→	→
	• creates problems that exemplify the concepts learned.	→	→	→	→	→	→	→

PRE-GRADE 1

PROBLEM SOLVING

Through problem solving, students develop and apply knowledge and skills within and across the strands. Strategies and skills for problem solving are presented in the chart on pages B.1 and B.2.

NUMERATION

General Learner Expectations

Related Specific Learner Expectations

In a problem-solving context, the student:

Patterns

In solving problems, the student recognizes and uses patterns.

- uses two or more different actions and manipulatives to:
  - identify a pattern
  - reproduce a pattern
  - create a pattern
  - extend a pattern; e.g., 2 red buttons, 3 blue buttons, 2 red buttons, 3 blue buttons and 2 claps, 3 snaps, 2 claps, 3 snaps

Whole Numbers

In solving problems, the student demonstrates understanding of sets and whole numbers 1 to 9.

- sorts objects into sets according to attributes and describes these attributes
- matches members of two sets of manipulatives, and describes the relationship between the two sets, using the terms more than, greater than, fewer than, less than, the same as/equal to (no written symbols)
- counts the number of objects in a set
- represents numbers, by:
  - creating sets, using manipulatives and diagrams, and making the connection with their spoken terms and written symbols
  - illustrating spoken terms and written symbols, using manipulatives and diagrams
- orders sets, based on the number of objects in the sets.

OPERATIONS AND PROPERTIES

General Learner Expectations	Related Specific Learner Expectations
	In a problem-solving context, the student:
	Addition and Subtraction of Whole Numbers
In solving problems, the student demonstrates awareness of addition and subtraction.	● represents the processes of addition and subtraction through role playing and the use of manipulatives.

MEASUREMENT

General Learner Expectations

In solving problems, the student compares the length, capacity, mass and temperature of objects, and demonstrates awareness of the passage of time and the concept of exchange.

Related Specific Learner Expectations

In a problem-solving context, the student:

Time

- recognizes terms expressing the passage of time: now, not now, before, after, long time, short time, yesterday, today, tomorrow

Length

- uses the terms: big, small, tall, long, short
- compares and orders two or more objects according to length, height and thickness
- uses nonstandard units for measuring length; e.g., paper clips of the same length

Capacity

- uses the terms: empty, full
- uses nonstandard units for measuring capacity; e.g., dixie cups
- compares the amount in two identical containers as more than, less than, the same as

Mass

- uses the terms: heavy, light
- uses nonstandard units for measuring mass; e.g., sugar cubes
- compares two objects as heavier than, lighter than, the same as; e.g., holding the objects in one's hands

Temperature

- uses the terms: hot, cold
- compares two or more objects as hotter than, colder than, the same as, and puts objects in order according to their temperature

Money

- recognizes that purchasing involves an exchange of money or tokens for goods or services.

General Learner Expectations	Related Specific Learner Expectations
	In a problem-solving context, the student:
	Collecting and Recording Data
In solving problems from daily life, the student, with guidance, collects, displays and interprets data.	• creates categories for data collection, starting with two categories and extending to more than two • collects first-hand information, by: – counting objects – conducting polls and surveys
	Organizing and Displaying Data
	• constructs concrete/object graphs, using one-to-one correspondence
	Interpreting Displayed Data
	• compares data in two or more categories, using the terms: greater than, more than, less than, fewer than, the same as • interprets data to solve problems • creates a new problem from the displayed data.

PROBLEM SOLVING

Through problem solving, students develop and apply knowledge and skills within and across the strands. Strategies and skills for problem solving are presented in the chart on pages B.1 and B.2.

NUMERATION

General Learner Expectations

Related Specific Learner Expectations

In a problem-solving context, the student:

Patterns

In solving problems, the student recognizes, uses and compares patterns.

- uses actions, manipulatives, diagrams, spoken terms and written symbols to:
  - identify a pattern
  - reproduce a pattern
  - create a pattern
  - extend a pattern; e.g., A B A B or 1 2 1 2
- translates a pattern from one form to another; e.g., actions, manipulatives, diagrams, spoken terms, written symbols
- identifies the similarities and differences among patterns
- identifies and constructs patterns, counting by 10s to 100, by making the connection with manipulatives, diagrams, spoken terms and written symbols; e.g., 10, 20, 30 or 14, 24, 34

Whole Numbers

In solving problems, the student demonstrates understanding of sets and whole numbers 0 to 100 and whole number relationships 0–10.

- estimates the number of objects in a set (0–50), counts them and compares the result with the estimate
- creates at least two different ways of sorting objects
- matches two sets of manipulatives or diagrams, and describes the relationship between the two sets, using more than, less than, greater than, fewer than, the same as/equal to (no written symbols)
- describes a number (0–10), using different arrangements and combinations of objects within a set; e.g., 6 is one more than 5, 2 groups of 3, 3 groups of 2, 1 group of 4 and 1 group of 2

- represents numbers, by:
  - reading and writing from manipulatives and diagrams
  - illustrating spoken terms and written symbols, using manipulatives and diagrams
- counts the number of objects in a set by placing them into groups of 10
- represents the order of numbers (0–10), by:
  - sequencing sets of manipulatives or diagrams, and making the connection with their spoken terms and written symbols
  - using spoken terms and written symbols, and verifying correctness with manipulatives and diagrams

Fractions

In solving problems, the student demonstrates understanding of fractions (half).

- represents a proper fraction that describes one of two equal parts of a region, by:
  - making the connection between manipulatives and diagrams and the spoken term one half
  - illustrating the spoken term one half, using manipulatives and diagrams.

OPERATIONS AND PROPERTIES

General Learner Expectations	Related Specific Learner Expectations
	In a problem-solving context, the student:
	Addition and Subtraction of Whole Numbers
In solving problems, the student demonstrates understanding of addition and subtraction of whole numbers (facts to 10).	• shows the process of addition, putting two sets together, using manipulatives and diagrams • shows the process of subtraction; taking away, missing addend, comparison, using manipulatives and diagrams • adds and subtracts numbers to 10, by: – making the connection with manipulatives, spoken terms and the written symbols; e.g., $3+2=5$, $\begin{array}{r}3\\+2\\\hline 5\end{array}$, $5-3=2$, $\begin{array}{r}5\\-3\\\hline 2\end{array}$ – illustrating spoken terms and written symbols, using manipulatives and diagrams • recalls, without hesitation, addition and subtraction facts to 5 • adds and subtracts, without hesitation, using 0 and 1 • calculates, mentally, by counting forward and backward from a given number
	Properties of Operations
In solving problems, the student demonstrates awareness of the commutative property of addition (to 10).	• shows the commutative property of addition, using manipulatives and diagrams; e.g., 3 girls and 2 boys total the same number of children as 2 boys and 3 girls.

General Learner Expectations

In solving problems, the student estimates, measures and compares time, length, capacity, mass, temperature and money.

Related Specific Learner Expectations

In a problem-solving context, the student:

Time

- uses terms expressing the passage of time: before, after, long time, short time, yesterday, today, tomorrow
- uses terms to indicate that time is divided into parts; e.g., seconds, minutes, hours, days, weeks, months, years
- associates the position of the hands on an analog clock, or the display of numbers on a digital clock, with familiar activities; e.g., recognizes when it is recess by looking at the clock
- estimates and reads time, to the nearest hour, for analog and digital clocks
- recites and orders the days of the week

Length

- estimates, measures, compares and orders length, using nonstandard units; e.g., paper clips of the same length

Capacity

- estimates and measures capacity, using nonstandard units; e.g., dixie cups
- compares the capacity of any two containers as holding more than, less than or the same as

Mass

- estimates and measures mass, using nonstandard units; e.g., sugar cubes
- compares two objects as heavier than, lighter than, the same as, using a balance scale

Temperature

- examines two or more Celsius thermometers, and compares temperatures as hotter than, colder than

Money

- recognizes and states the value of pennies, nickels, dimes, quarters and dollar coins
- gives equivalent value of coins up to and including 10 cents; e.g., the same value is represented by one dime, two nickels, one nickel and five pennies, or ten pennies
- estimates and counts collections of coins up to and including $1, using dimes and pennies.

General Learner Expectations

In solving problems, the student uses objects from the real world to classify three-dimensional objects by sorting them into different groups, and to classify and name some two-dimensional figures.

Related Specific Learner Expectations

In a problem-solving context, the student:

Spatial Relationships

- describes spatial relationships, using the terms: inside, outside, in front of, behind, on, under, up, down, here, there, over, above, below, between, near

Patterns

- translates a pattern from one form to another; e.g., manipulatives, diagrams, spoken terms, written symbols
- identifies the similarities and differences among patterns

Classification of Three-dimensional Objects and Two-dimensional Figures

- classifies three-dimensional objects from the real world, by:
  - creating at least two different ways of sorting the objects
  - describing the attributes used in sorting; e.g., objects could be classified as balls, cones or boxes; or as objects that roll or do not roll
- classifies and names two-dimensional figures as circles, squares, triangles or rectangles, by:
  - using objects from the real world
  - using diagrams of each type that include a wide variety of sizes, shapes and positions
  - using sets, including types other than circles, squares, triangles or rectangles; e.g., ovals, figures that contain four sides or more than four sides

Symmetry

- identifies symmetrical objects in the real world.

General Learner Expectations	Related Specific Learner Expectations
	In a problem-solving context, the student:
In solving problems from daily life, the student collects, displays and interprets data and describes the chance of an event happening in terms of never, sometimes and always.	**Collecting and Recording Data** • creates two or more categories for data collection • collects first-hand information, by: – counting objects – conducting polls and surveys – conducting experiments – using measuring devices (nonstandard units) **Organizing and Displaying Data** • constructs concrete/object graphs and pictographs, using one-to-one correspondence • discusses the purpose of labels and titles on a graph **Interpreting Displayed Data** • describes data, using the terms: more than, greater than, less than, the same as, fewer, most, least, altogether, how many fewer, how many more, equal to • describes the chance of certain events happening (probability), using the terms: never, sometimes, always • interprets displayed data to solve problems • creates new problems from displayed data.

GRADE 2

PROBLEM SOLVING

Through problem solving, students develop and apply knowledge and skills within and across the strands. Strategies and skills for problem solving are presented in the chart on pages B.1 and B.2.

NUMERATION

General Learner Expectations	Related Specific Learner Expectations
	In a problem-solving context, the student:
	Patterns
In solving problems, the student recognizes and applies patterns with whole numbers to 100.	• identifies and constructs patterns, counting by 2s and 5s to 100, by making the connection with manipulatives, diagrams, spoken terms, written symbols and a calculator • identifies and constructs multiples, counting by 100s to 900, by making the connection with manipulatives, diagrams, spoken terms, written symbols and a calculator • compares patterns illustrating multiples of 10 with patterns illustrating multiples of 2, 5 and 100 • describes the attributes of odd and even numbers (0–100), by making the connection with manipulatives, diagrams, spoken terms, written symbols and a calculator
	Whole Numbers and Place Value
In solving problems, the student demonstrates understanding of whole number relationships 0 to 999.	• estimates the number of objects in a set (0–100), counts them and compares the result with the estimate • describes a number (0–100), using different arrangements and combinations of objects within a set; e.g., 20 is one more than 19, 2 groups of 10, 10 groups of 2, 1 group of 12 and 1 group of 8 • represents numbers, by: – reading and writing from manipulatives and diagrams – illustrating spoken terms and written symbols, using manipulatives and diagrams

- describes the relationship among place values (1s, 10s, 100s), including regrouping, by making the connection with manipulatives, diagrams, spoken terms and written symbols; e.g., 245 can be represented by 1 hundred, 14 tens and 5 ones
- identifies and names the place value of digits, by making the connection with manipulatives, diagrams, spoken terms and written symbols
- represents the order of numbers (0–100), by:
  - sequencing sets of manipulatives or diagrams, and making the connection with their spoken terms and written symbols
  - using spoken terms and written symbols, and verifying correctness with manipulatives and diagrams
- names and uses ordinal numbers (numbers that denote order of the members of a set) first to tenth, by making the connection with manipulatives, diagrams, spoken terms and written symbols

Fractions

In solving problems, the student demonstrates understanding of proper fractions (halves, thirds and quarters/fourths).

- represents proper fractions ($\frac{1}{2}$, $\frac{1}{3}$, $\frac{2}{3}$, $\frac{1}{4}$, $\frac{2}{4}$, $\frac{3}{4}$) that describe equal parts of a region or group, by:
  - reading and writing from manipulatives and diagrams
  - illustrating spoken terms and written symbols, using manipulatives and diagrams.

OPERATIONS AND PROPERTIES

General Learner Expectations

Related Specific Learner Expectations

In a problem-solving context, the student:

Addition and Subtraction of Whole Numbers

In solving problems, the student demonstrates understanding of addition and subtraction of whole numbers (limit: two-digit numbers).

- applies addition and subtraction facts to 18, using manipulatives, diagrams, doubles, tens, when adding or subtracting eights or nines; e.g., $6+9 \rightarrow 6+10=16$, one less is 15
- recalls, without hesitation, addition and subtraction facts to 10
- estimates sums and differences, sums and minuends to 99
- adds and subtracts, sums and minuends to 99, with and without regrouping, by:
  - making the connection between manipulatives and diagrams and a paper and pencil procedure
  - generating a paper and pencil solution, and verifying correctness with manipulatives and diagrams
- calculates, mentally, using trailing zeros, when adding or subtracting multiples of 10; e.g., $70-20=7$ tens $-$ 2 tens $=$ 5 tens $=50$

Multiplication and Division of Whole Numbers

In solving problems, the student demonstrates understanding of the process of multiplication and division.

- shows the process of multiplication, using manipulatives and diagrams (no written number sentences; e.g., $2 \times 3=6$)
- shows the process of division, equal sharing and repeated subtraction of equal groups, using manipulatives and diagrams (no written number sentences)

Properties of Operations

In solving problems, the student demonstrates understanding of the commutative property of addition (limit: two-digit numbers).

- describes the commutative property of addition represented by manipulatives and diagrams; e.g., a nickel and a dime total the same amount of money as a dime and a nickel

Appropriate Computational Methods

In solving problems, the student chooses the appropriate calculation methods.

- selects and uses appropriate calculation methods; e.g., estimation, mental calculation, paper and pencil, calculator.

MEASUREMENT

General Learner Expectations

In solving problems, the student estimates, measures and compares time, length, capacity, mass, temperature and money.

Related Specific Learner Expectations

In a problem-solving context, the student:

Time

- estimates, reads and writes time to the nearest hour, half hour and quarter hour, using standard notation for both analog and digital clocks; e.g., 5:15
- reads dates on a calendar
- recites the months of the year in order

Length

- estimates, measures, compares and orders length, using standard units with correct symbols (cm and m)

Capacity

- compares and orders two or more containers as being more than, less than or the same as, using nonstandard units of measure; e.g., dixie cups containing sand

Mass

- compares two or more objects as heavier than, lighter than, or the same as, using nonstandard units of measure on a balance scale; e.g., number of sugar cubes required to balance each object

Temperature

- estimates temperature, reads the Celsius thermometer to one degree intervals, and uses the symbol °C

Money

- estimates amounts, counts collections, gives equivalent value of coins (dimes, nickels, pennies), up to and including $1, by making the connection with manipulatives, diagrams, spoken terms and written symbols
- makes purchases up to and including $1, by making the connection with manipulatives, diagrams, spoken terms and written symbols.

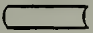
General Learner Expectations

In solving problems, the student classifies three-dimensional objects by relating them to real objects, and classifies and names some two-dimensional figures.

Related Specific Learner Expectations

In a problem-solving context, the student:

Classification of Three-dimensional Objects and Two-dimensional Figures

- classifies three-dimensional objects, by:
  - relating objects in the real world to models of spheres, cylinders, cones, prisms, pyramids
  - identifying vertices, edges, faces and curved surfaces
- classifies and names two-dimensional figures as circles, squares, triangles or rectangles, by:
  - tracing the faces of three-dimensional objects
  - using sets, other than those described; e.g., figures with sides and curves 
  - identifying the corners (vertices), sides and curves

Symmetry

- creates and verifies symmetrical figures by folding and/or cutting.

DATA MANAGEMENT

General Learner Expectations

In solving problems, the student collects, displays and interprets data, and compares the chances of events happening in terms of more likely or less likely.

Related Specific Learner Expectations

In a problem-solving context, the student:

Collecting and Recording Data

- creates categories for data collection
- collects first-hand information, by:
  - counting objects
  - conducting polls and surveys
  - conducting experiments
  - using measuring devices (cm, m)
- uses tallies to record data; e.g., 7 is represented by 𝍸 //

Organizing and Displaying Data

- constructs concrete/object graphs, pictographs and bar graphs, using one-to-one correspondence
- writes labels and titles on graphs

Interpreting Displayed Data

- describes the chance of certain events happening (probability), using the terms: never, sometimes, always, probably, likely, unlikely, more likely, less likely
- interprets displayed data to solve problems
- creates new problems from displayed data.

GRADE 3

PROBLEM SOLVING

Through problem solving, students develop and apply knowledge and skills within and across the strands. Strategies and skills for problem solving are presented in the chart on pages B.1 and B.2.

NUMERATION

General Learner Expectations

Related Specific Learner Expectations

In a problem-solving context, the student:

Patterns

In solving problems, the student recognizes and applies patterns with whole numbers to 1000.

- identifies and constructs multiples, counting by 25s, by making the connection with manipulatives, diagrams, spoken terms, written symbols and a calculator
- counts forward and backward from any number by 2s and 5s, by making the connection with manipulatives, diagrams, spoken terms, written symbols and the constant feature of a calculator
- compares patterns illustrating multiples of 5 and 100 with patterns illustrating multiples of 25
- describes the attributes of odd and even numbers (0–1000), by making the connection with manipulatives, diagrams, spoken terms, written symbols and a calculator

Whole Numbers, Decimals and Place Value

In solving problems, the student demonstrates understanding of number relationships from tenths to thousands.

- estimates the number of objects in a set (0–500), counts them and compares the result with the estimate
- represents numbers, by:
  - reading and writing symbols; e.g., 1352, and number words; e.g., one thousand three hundred fifty-two, from manipulatives and diagrams
  - illustrating spoken terms, written symbols and number word forms, using manipulatives and diagrams
- describes the relationship among place values, tenths to thousands, including regrouping, by making the connection with manipulatives, diagrams, spoken terms and written symbols

- identifies and names the place value of digits, by making the connection with manipulatives, diagrams, spoken terms and written symbols
- represents whole numbers (0–9999), by:
  - writing in expanded form; e.g., $235=200+30+5$, and showing the relationship of the expanded form to manipulatives and diagrams
  - writing expanded forms as single numbers; e.g., $200+30+5=235$
- represents the order of numbers (0–1000), by:
  - sequencing sets of manipulatives or diagrams, and making the connection with their spoken terms and written symbols
  - using spoken terms and written symbols, and verifying correctness with manipulatives and diagrams
- describes the relationship between two numbers, using the terms: greater than, less than, equal to and their symbols ($>$, $<$, $=$)
- names and uses ordinal numbers (numbers that denote order of the members of a set) first to hundredth

Fractions and Decimals

In solving problems, the student demonstrates understanding of proper fractions (fifths, tenths) and relates tenths to decimals.

- represents proper fractions ($\frac{1}{5}$ to $\frac{4}{5}$, $\frac{1}{10}$ to $\frac{9}{10}$) that describe equal parts of a region or group, by:
  - reading and writing from manipulatives and diagrams
  - illustrating spoken terms and written symbols, using manipulatives and diagrams
- shows that tenths, written as proper fractions or as decimals are equivalent, by making the connection with manipulatives, diagrams, spoken terms and written symbols; e.g., $\frac{1}{10}$ is the same as 0.1.

OPERATIONS AND PROPERTIES

General Learner Expectations

Related Specific Learner Expectations

In a problem-solving context, the student:

Addition and Subtraction of Whole Numbers

In solving problems, the student demonstrates understanding of addition and subtraction of whole numbers (limit: three-digit numbers).

- recalls, without hesitation, addition and subtraction facts to 18
- estimates sums and differences of any whole numbers (limit: three-digit numbers), using the front-end method; e.g., focus on the front-end amounts: $159+232 \rightarrow 100+200 \rightarrow 300$
- adds and subtracts any two- or three-digit numbers, by:
  - making the connection between manipulatives and diagrams and a paper and pencil procedure
  - generating a paper and pencil solution, and verifying correctness with manipulatives and diagrams
- calculates, mentally, using compatible numbers when adding or subtracting; e.g., $35+59=35+60-1=94$ or $72-39=73-40=33$
- shows the relationship between addition and subtraction, by:
  - making the connection between manipulatives and diagrams and related number sentences; e.g., $2+3=5$, $3+2=5$ and $5-2=3$, $5-3=2$
  - generating related number sentences, and verifying correctness with manipulatives and diagrams

Multiplication and Division of Whole Numbers

In solving problems, the student demonstrates understanding of multiplication and division of whole numbers (facts to 45).

- multiplies and divides numbers to 45, by:
  - making the connection among manipulatives and diagrams, spoken terms and written symbols; e.g., $3\times 8=24$, $\begin{array}{r}8\\ \times 3\\ \hline 24\end{array}$, $24\div 3=8$, $\begin{array}{r}8\\ 3\overline{)24}\end{array}$
  - illustrating spoken terms and written symbols, using manipulatives and diagrams
- multiplies one-digit whole numbers, mentally, by 10 and 100, and explains why the answer is correct
- shows the relationship between multiplication and division, by:
  - making the connection between manipulatives and diagrams and related number sentences
  - generating related number sentences, and verifying correctness with manipulatives and diagrams

Properties of Operations

In solving problems, the student demonstrates understanding of the commutative property of addition and multiplication, and the effect of adding 0 or multiplying by 1.

- describes the commutative property of addition and multiplication, by making the connection with manipulatives, diagrams, spoken terms and written symbols; e.g., $3+5=5+3$, $3\times5=5\times3$
- describes the unique effect of 0 in addition, and 1 in multiplication, by making the connection with manipulatives, diagrams, spoken terms and written symbols

Appropriate Computational Methods

In solving problems, the student chooses the appropriate calculation methods.

- selects and uses the appropriate calculation methods; e.g., estimation, mental calculation, paper and pencil, calculator.

General Learner Expectations

In solving problems, the student estimates, measures and compares time, length, capacity, mass and money, using standard units.

Related Specific Learner Expectations

In a problem-solving context, the student:

Time

- estimates, reads and writes time to the nearest 5-minute interval, using standard notation for both analog and digital clocks; e.g., 5:05
- uses a clock to identify the resulting time when adding or subtracting time intervals
- orders the months of the year

Length

- estimates, measures, compares and orders length, using standard units with symbols (cm, dm, m, km)

Capacity

- estimates, measures, compares and orders capacity, using standard units with symbols (mL, L)

Mass

- estimates, measures, compares and orders mass, using standard units with symbols (g, kg)

Money

- estimates amounts, counts collections, gives equivalent value of all coins and bills up to and including $5, by making the connection with manipulatives, diagrams, spoken terms and written symbols (no algorithms)
- makes purchases and change up to and including $5, by making the connection with manipulatives, diagrams, spoken terms and written symbols.

General Learner Expectations	Related Specific Learner Expectations
	In a problem-solving context, the student:
	Classification of Three-dimensional Objects and Two-dimensional Figures
In solving problems, the student classifies, names and constructs three-dimensional objects and two-dimensional figures.	• classifies three-dimensional objects by naming them, using the terms: spheres, cylinders, cones, prisms, pyramids • classifies two-dimensional figures, by: – describing the attributes of squares, triangles and rectangles; e.g., a rectangle is a four-sided figure with four square corners – describing the relationship among squares, rectangles and triangles; e.g., similarities, differences, all squares are rectangles
	Construction
	• constructs three-dimensional objects, prisms and spheres, using straws, pipe cleaners, moulding clay • constructs two-dimensional figures, 3, 4, 5, 6 and 8 sides, using toothpicks, geoboards
	Symmetry
	• identifies two-dimensional figures as symmetrical, by drawing lines of symmetry.

DATA MANAGEMENT

General Learner Expectations

In solving problems, the student collects, displays and interprets data and identifies events as impossible, uncertain and certain.

Related Specific Learner Expectations

In a problem-solving context, the student:

Collecting and Recording Data

- creates categories for data collection
- collects first-hand information, by:
  - counting objects
  - conducting polls and surveys
  - conducting experiments
  - using measuring devices (cm, dm, m, km, mL, L, g, kg)
- extracts data from given sources, such as tables, lists, pictures, graphs, books, articles, printed materials, visual materials
- uses tallies in a chart to record data; e.g., flipping a coin

Event	Tally	Frequency
heads	𝍸 𝍸 //	12
tails	𝍸 ///	8
	TOTAL	20

Organizing and Displaying Data

- organizes data, using rank ordering; i.e., smallest to largest or largest to smallest
- constructs pictographs and bar graphs, using two-to-one, five-to-one, and ten-to-one correspondence
- constructs graphs, by:
  - placing an object on a grid, using columns and rows
  - describing the position of an object on a grid, referring to columns and rows
- displays data in two different ways; e.g., pictograph, bar graph

Interpreting Displayed Data

- identifies events as impossible, uncertain or certain
- interprets displayed data to solve problems
- creates new problems from displayed data.

GRADE 4

PROBLEM SOLVING

Through problem solving, students develop and apply knowledge and skills within and across the strands. Strategies and skills for problem solving are presented in the chart on pages B.1 and B.2.

NUMERATION

General Learner Expectations

In solving problems, the student demonstrates understanding of number relationships from hundredths to ten thousands.

Related Specific Learner Expectations

In a problem-solving context, the student:

Whole Numbers, Decimals and Place Value

- estimates the number of objects in a set (0–1000), counts them and compares the result with the estimate
- reads, writes and orders whole numbers and decimals, by making the connection with manipulatives, diagrams, spoken terms and written symbols
- describes the relationship among place values, hundredths to ten thousands, including regrouping, by making the connection with manipulatives, diagrams, spoken terms and written symbols
- constructs equivalent decimals, tenths and hundredths, using manipulatives and diagrams, and by making the connection with spoken terms and written symbols
- identifies and names the place values of digits, by making the connection with manipulatives, diagrams, spoken terms and written symbols
- represents whole numbers (0–99 999), by:
  - writing in expanded form; e.g., 54 213 = 50 000 + 4000 + 200 + 10 + 3
  - writing expanded forms as single numbers; e.g., 50 000 + 4000 + 200 + 10 + 3 = 54 213
- rounds whole numbers to the nearest ten, hundred, thousand, by making the connection with manipulatives, diagrams, spoken terms and written symbols
- rounds decimals to the nearest whole number, by making the connection with manipulatives, diagrams, spoken terms and written symbols

Fractions and Decimals

In solving problems, the student demonstrates understanding of proper fraction relationships and relates hundredths to decimals.

- represents proper fractions, $\frac{1}{100}$ to $\frac{99}{100}$, that describe equal parts of a region or group, by:
  - reading and writing from manipulatives and diagrams
  - illustrating spoken terms and written symbols, using manipulatives and diagrams
- shows that hundredths, written as proper fractions or decimals, are equivalent, by making the connection with manipulatives, diagrams, spoken terms and written symbols
- constructs equivalent proper fractions, halves, thirds, quarters, fifths, tenths and hundredths, using manipulatives and diagrams, and makes the connection with spoken terms and written symbols
- represents halves, thirds, quarters, fifths, tenths and hundredths as points on a number line
- compares proper fractions, represented by manipulatives and diagrams, using the terms: greater than, less than, equal to, and their symbols (>, <, =).

OPERATIONS AND PROPERTIES

General Learner Expectations

Related Specific Learner Expectations

In a problem-solving context, the student:

Addition and Subtraction of Whole Numbers

In solving problems, the student demonstrates understanding of addition and subtraction of whole numbers (limit: four-digit numbers).

- estimates sums and differences of whole numbers (limit: four-digit numbers), using the front-end method; e.g., focus on the front-end amounts: $1596+2327 \rightarrow 1000+2000 \rightarrow 3000$, or rounding with compensation
- adds and subtracts (limit: four-digit numbers), by:
  - making the connection between manipulatives and diagrams and a paper and pencil procedure
  - generating a paper and pencil solution, and verifying correctness with manipulatives and diagrams
- shows the relationship between addition and subtraction of whole numbers, using addition to check subtraction

Multiplication and Division of Whole Numbers

In solving problems, the student demonstrates understanding of multiplication and division of whole numbers (one-digit multipliers and divisors).

- multiplies and divides numbers to 81, by:
  - making the connection among manipulatives and diagrams, spoken terms and written symbols; e.g., $7 \times 8 = 56$, $56 \div 7 = 8$, $7\overset{8}{\overline{)56}}$
  - illustrating spoken terms and written symbols, using manipulatives and diagrams
- recalls, without hesitation, multiplication and division facts to 81
- calculates, mentally, to multiply:
  - whole numbers by 10, 100 and 1000
  - multiples of 10, 100 and 1000; e.g., $30 \times 500 = 15\,000$
- estimates products of two- and three-digit whole numbers and one-digit multipliers, using the front-end method or rounding with compensation
- multiplies two- and three-digit whole numbers by one-digit whole numbers, by:
  - making the connection between manipulatives and diagrams and a paper and pencil procedure
  - generating a paper and pencil solution, and verifying correctness with manipulatives and diagrams

- estimates quotients of two-digit whole numbers and one-digit divisors, using compatible numbers; e.g., $70 \div 8 \rightarrow 72 \div 8 = 9$, with compensation
- divides one- and two-digit whole numbers by a one-digit whole number divisor, with and without remainders, by:
  - making the connection between manipulatives and diagrams and the paper and pencil procedure
  - generating a paper and pencil solution, and verifying correctness with manipulatives and diagrams
- shows the relationship between multiplication and division of whole numbers, using multiplication to check division

Properties of Operations

In solving problems, the student demonstrates understanding of commutative, associative and distributive properties.

- describes the commutative and associative properties of addition and multiplication, by making the connection with manipulatives, diagrams, spoken terms and written symbols; e.g., $\$0.25 + \$0.75 = \$0.75 + \$0.25$, $7 \times 8 = 8 \times 7$
- applies the commutative and associative properties in mental calculation by searching for compatible numbers; e.g., $4 \times 8 \times 50 = 4 \times 50 \times 8 = 200 \times 8 = 1600$
- describes the distributive property, by making the connection with manipulatives, diagrams, spoken terms and written symbols
- applies the distributive property in mental calculation; e.g., 4×35 can be found by adding 4 thirties and 4 fives

Addition and Subtraction of Decimals

In solving problems, the student demonstrates understanding of addition and subtraction of decimals.

- estimates sums and differences of decimals, to hundredths, by using the front-end method; e.g., focus on the front-end amounts: $\$4.79 + \$1.26 \rightarrow \$4 + \$1 \rightarrow \$5$, or rounding to the nearest whole number with compensation
- adds and subtracts decimals, to hundredths, by:
  - making the connection between manipulatives and diagrams and a paper and pencil procedure
  - generating a paper and pencil solution, and verifying correctness with manipulatives and diagrams
- shows the relationship between the addition and subtraction of decimals, using addition to check subtraction

Appropriate Computational Methods

In solving problems, the student chooses the appropriate calculation methods.

- selects and uses the appropriate calculation methods; e.g., estimation, mental calculation, paper and pencil, calculator.

MEASUREMENT

General Learner Expectations

In solving problems, the student estimates, measures and/or calculates and compares time, length, capacity, mass, temperature, money, perimeter and area (no formulas).

Related Specific Learner Expectations

In a problem-solving context, the student:

Time

- estimates, reads and writes time to the nearest minute, using standard notation for both analog and digital clocks; e.g., 5:06

Length

- estimates, measures, compares and orders length, using standard units with symbols (mm, cm, dm, m, km)
- selects and uses standard units for measuring length

Capacity

- selects and uses standard units for measuring capacity (mL, L)

Mass

- selects and uses standard units for measuring mass (g, kg)

Temperature

- reads a Celsius thermometer, and determines the reasonableness of readings in given situations

Money

- estimates amounts and gives equivalent value of coins and bills up to and including $9999
- makes purchases and change, up to and including $9999

Perimeter and Area

- estimates, finds and compares the perimeter of rectangles, by making the connection with manipulatives, diagrams, spoken terms and written symbols (no formulas)
- estimates, finds and compares the area of rectangles (nonstandard units; e.g., tiles of uniform size), by making the connection with manipulatives, diagrams, spoken terms and written symbols (no formulas).

General Learner Expectations

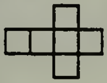
In solving problems, the student classifies, names and constructs three-dimensional objects and slides, and flips two-dimensional figures.

Related Specific Learner Expectations

In a problem-solving context, the student:

Classification of Three-dimensional Objects and Two-dimensional Figures

- relates three-dimensional objects to two-dimensional figures, by connecting nets with objects and naming them as cylinders, cones, prisms or pyramids; e.g.,

  the net for a cube could be 

Construction

- constructs three-dimensional objects, cylinders, cones, prisms, pyramids, using nets

Motion Geometry

- translates (slides) and reflects (flips) objects, and records their positions, by tracing the face of each object.

DATA MANAGEMENT

General Learner Expectations

In solving problems, the student collects, displays and interprets data from a variety of sources, and compares the likelihood of two events occurring.

Related Specific Learner Expectations

In a problem-solving context, the student:

Collecting and Recording Data

- creates categories for data collection
- collects first-hand information, by:
  - counting objects
  - conducting polls and surveys
  - conducting experiments
  - using measuring devices (mm, cm, dm, m, km, mL, L, g, kg)
- extracts data from given sources, such as tables, lists, pictures, graphs, books, articles, printed materials, visual materials
- uses tallies in a chart to record data

Organizing and Displaying Data

- organizes data, using rank ordering; i.e., smallest to largest or largest to smallest
- uses class intervals to group information; e.g., the number of sit ups performed by students in one minute may be grouped into class intervals of 0–19, 20–39, 40–59, and so on
- constructs pictographs and bar graphs, using two-to-one, five-to-one, ten-to-one and a hundred-to-one correspondence, and justifies the choice of correspondence
- graphs and writes coordinates for ordered pairs, first quadrant only
- describes the similarities and differences between data displayed in different ways; e.g., pictograph, bar graph

Interpreting Displayed Data

- describes data, using fractions, with the emphasis on halves, thirds, quarters, fifths, tenths and hundredths
- identifies events as impossible, uncertain or certain
- compares two events as equally likely, more likely or less likely
- interprets displayed data to solve problems
- creates new problems from displayed data.

GRADE 5

PROBLEM SOLVING

Through problem solving, students develop and apply knowledge and skills within and across the strands. Strategies and skills for problem solving are presented in the chart on pages B.1 and B.2.

NUMERATION

General Learner Expectations

In solving problems, the student demonstrates understanding of number relationships from thousandths to hundred thousands.

Related Specific Learner Expectations

In a problem-solving context, the student:

Whole Numbers, Decimals and Place Value

- reads, writes and orders whole numbers and decimals, by making the connection with manipulatives, diagrams, spoken terms and written symbols
- describes the relationship among place values, thousandths to hundred thousands, including regrouping, by making the connection with manipulatives, diagrams, spoken terms and written symbols
- generates equivalent decimals in symbolic form, and verifies their equivalence, using manipulatives and diagrams
- identifies and names the place value of digits, by making the connection with manipulatives, diagrams, spoken terms and written symbols
- represents whole numbers (0–999 999), by:
  - writing in expanded form; e.g., $735\ 681=(7\times 100\ 000)+(3\times 10\ 000)+(5\times 1\ 000)+(6\times 100)+(8\times 10)+(1\times 1)$
  - writing expanded forms as single numbers; e.g., $(7\times 100\ 000)+(3\times 10\ 000)+(5\times 1\ 000)+(6\times 100)+(8\times 10)+(1\times 1)=735\ 681$
- rounds whole numbers to the nearest ten thousand, by making the connection with manipulatives, diagrams, spoken terms and written symbols
- rounds decimals to the nearest tenth or hundredth, by making the connection with manipulatives, diagrams, spoken terms and written symbols

Fractions and Decimals

In solving problems, the student demonstrates understanding of proper fraction relationships and relates thousandths to decimals.

- shows that thousandths, written as proper fractions or decimals, are equivalent, by making the connection with manipulatives, diagrams, spoken terms and written symbols
- generates equivalent fractions, halves, thirds, quarters, fifths, tenths and hundredths, in symbolic form, and verifies their equivalence, using manipulatives and diagrams
- compares proper fractions, halves, thirds, quarters, fifths, tenths and hundredths, by generating equivalent fractions, and verifies correctness, using manipulatives and diagrams.

OPERATIONS AND PROPERTIES

General Learner Expectations

Related Specific Learner Expectations

In a problem-solving context, the student:

Addition and Subtraction of Whole Numbers

In solving problems, the student demonstrates understanding of addition and subtraction of whole numbers (limit: five-digit numbers).

- estimates sums and differences of whole numbers (limit: five-digit numbers), using the front-end method; e.g., focus on the front-end amounts: 15 968 + 23 275 → 10 000 + 20 000 → 30 000, or rounding with compensation
- calculates, mentally, using the left to right method; e.g., 356 + 527 = 800 + 70 + 13 = 883

Multiplication and Division of Whole Numbers

In solving problems, the student demonstrates understanding of multiplication and division of whole numbers (two-digit multipliers and one-digit divisors).

- multiplies and divides whole numbers, mentally, by 10, 100 and 1000, and explains why the answer is correct
- finds all the factors of whole numbers (limit: two-digit numbers), by making the connection with manipulatives, diagrams, spoken terms and written symbols; e.g., factors of 6 used in the dimensions of rectangles with an area of 6 cm^2 → 1 cm by 6 cm, 2 cm by 3 cm
- estimates products of whole numbers (limit: three-digit multipliers), using the front-end method or rounding with compensation
- multiplies whole numbers, using two-digit multipliers, by:
  - making the connection between manipulatives and diagrams and a paper and pencil procedure
  - generating a paper and pencil solution, and verifying correctness with manipulatives and diagrams
- estimates quotients of two-, three- and four-digit whole numbers and one-digit divisors, using compatible numbers; e.g., 736 ÷ 9 → 720 ÷ 9 = 80, with compensation
- divides one-, two-, three- and four-digit whole numbers, using one-digit divisors, by:
  - making the connection between manipulatives and diagrams and a paper and pencil procedure
  - generating a paper and pencil solution, and verifying correctness with manipulatives and diagrams
- shows the relationship between multiplication and division of whole numbers, using multiplication to check division

Addition and Subtraction of Decimals

In solving problems, the student demonstrates understanding of addition and subtraction of decimals.

- estimates sums and differences of decimals, to thousandths, using the front-end method; e.g., focus on the front-end amounts: $4.865\text{ m}+1.265\text{ m}+0.689\text{ m}\rightarrow 4\text{ m}+1\text{ m}+0\text{ m}\rightarrow 5\text{ m}$, or rounding with compensation
- adds and subtracts decimals to thousands, by:
  - making the connection between manipulatives and diagrams and a paper and pencil procedure
  - generating a paper and pencil solution, and verifying correctness with manipulatives and diagrams
- shows the relationship between addition and subtraction of decimals, using addition to check subtraction

Multiplication and Division of Decimals

In solving problems, the student demonstrates understanding of multiplication and division of decimals (two-digit multipliers and one-digit divisors).

- multiplies and divides decimals, mentally, by 10, 100 and 1000, and explains why the answer is correct
- estimates products of decimals multiplied by whole numbers, using the front-end method or rounding with compensation
- multiplies decimals, multiplicands to thousandths, by one- and two-digit whole number multipliers, by:
  - making the connection between manipulatives and diagrams and a paper and pencil procedure
  - generating a paper and pencil solution, and verifying correctness with manipulatives and diagrams
- estimates quotients of decimals, dividends to hundredths, divided by one-digit whole numbers, using compatible numbers; e.g., $\$58.75\div 8\rightarrow\$56\div 8=\$7$ with compensation
- divides decimals, dividends to hundredths, by one-digit whole number divisors, by:
  - making the connection between manipulatives and diagrams and a paper and pencil procedure
  - generating a paper and pencil solution, and verifying correctness with manipulatives and diagrams
- shows the relationship between multiplication and division of decimals, using multiplication to check division

Using Appropriate Terms

In solving problems, the student uses appropriate terms.

- uses the terms: sum, difference, factor, product, divisor, dividend, quotient

Appropriate Computational Methods

In solving problems, the student chooses the appropriate calculation methods.

- selects and uses appropriate calculation methods; e.g., estimation; mental calculation; paper and pencil; calculator, including the memory feature.

MEASUREMENT

General Learner Expectations

In solving problems, the student estimates, measures and/or calculates and compares time, length, capacity, mass, money, perimeter, area and volume (no formulas).

Related Specific Learner Expectations

In a problem-solving context, the student:

Time

- estimates, reads and writes time to seconds, using standard notation; e.g., 5:46:23

Length

- expresses equivalent linear measures, by making the connection with manipulatives, diagrams, spoken terms and written symbols (mm, cm, dm, m, km)
- expresses linear measure to the nearest tenth, hundredth and thousandth of a metre, by making the connection with manipulatives and diagrams, spoken terms and written symbols

Capacity

- selects and uses standard units for measuring capacity (mL, L, kL)

Mass

- selects and uses standard units for measuring mass (g, kg, t)

Money

- makes purchases and change for any amount

Perimeter, Area and Volume

- estimates, finds and compares the perimeter of polygons, by making the connection with manipulatives, diagrams, spoken terms and written symbols (no formulas)
- estimates, finds and compares the area of polygons (standard units), by making the connection with manipulatives, diagrams, spoken terms and written symbols (no formulas)

- shows the relationship between perimeter and area, using manipulatives and diagrams to:
  - construct rectangles that have the same perimeter but different areas
  - construct rectangles that have the same area but different perimeters
- estimates, finds and compares the volume of right rectangular prisms, by making the connection with manipulatives, diagrams, spoken terms and written symbols (no formulas).

General Learner Expectations	Related Specific Learner Expectations
	In a problem-solving context, the student:
	Classification of Three-dimensional Objects and Two-dimensional Figures
In solving problems, the student classifies and names three-dimensional objects, and slides, flips and turns two-dimensional figures.	• classifies three-dimensional objects, by: – describing the attributes of prisms, pyramids, cones, cylinders and spheres; e.g., a cylinder is a three-dimensional object that has one curved surface and two circular bases of the same size and shape – naming prisms and pyramids, by identifying the shape of the base, using objects or nets; e.g., a triangular prism has a triangular base • classifies and names two-dimensional figures, using the terms: circles, triangles, squares, rectangles, polygons, pentagons, hexagons, octagons • uses the terms: line segment, line, ray, angle
	Motion Geometry
	• identifies and draws translations (slides) and reflections (flips) of two-dimensional figures • rotates (turns) objects on a vertex, edge or centre, and records their positions, by tracing the face of each object.

DATA MANAGEMENT

General Learner Expectations

In solving problems, the student collects, displays and interprets data from a variety of sources, distinguishes among types of displays and compares the results of probability experiments.

Related Specific Learner Expectations

In a problem-solving context, the student:

Collecting and Recording Data

- creates categories for data collection
- collects first-hand information, by:
  - counting objects
  - conducting polls and surveys
  - conducting experiments
  - using measuring devices
- extracts data from self-researched sources, such as tables, lists, pictures, graphs, books, articles, printed materials, visual materials
- compares data collected first-hand with data from other sources, such as tables lists, pictures, graphs, books, articles, printed materials, visual materials
- uses tallies in a chart to record data

Organizing and Displaying Data

- organizes data, using rank ordering; i.e., increasing or decreasing order
- selects and uses class intervals to group information; e.g., the ages of students may be grouped into class intervals of 5 to 9 years, 10 to 14 years, 15 to 19 years
- constructs bar graphs, up to 1000 to 1, and justifies the choice of correspondence
- graphs and writes coordinates for ordered pairs, first quadrant only
- constructs line graphs
- constructs stem-and-leaf plots; e.g., to organize and display the number of pushups done by different people in one minute, keeping the data intact:

Stem-and-leaf Plot

Pushups
15, 15, 19,
27, 28

Stem	Leaf
1	5, 5, 9
2	7, 8

1/5 represents 15 pushups

- distinguishes among types of graphs, and discusses reasons for using each type of graph

Interpreting Displayed Data

- compares two or more events as equally likely, more likely or less likely
- creates situations to exemplify events as impossible, uncertain, certain, equally likely, more likely or less likely
- conducts two probability experiments with common events, and identifies which experiment would more likely yield a specified outcome; e.g., choosing a yellow bead from two different sets of yellow and blue beads, if one set has 3 yellow and 2 blue beads, and the other has 4 yellow and 6 blue beads
- interprets displayed data to solve problems
- creates new problems from displayed data.

GRADE 6

PROBLEM SOLVING

Through problem solving, students develop and apply knowledge and skills within and across the strands. Strategies and skills for problem solving are presented in the chart on pages B.1 and B.2.

NUMERATION

General Learner Expectations

Related Specific Learner Expectations

In a problem-solving context, the student:

Whole Numbers, Decimals and Place Value

In solving problems, the student demonstrates understanding of number relationships from thousandths to billions.

- reads, writes and orders whole numbers and decimals
- describes the relationship among place values, thousandths to billions, including regrouping, by making the connection with manipulatives, diagrams, spoken terms and written symbols, where appropriate
- identifies and names the place value of digits
- represents decimals, by:
  - writing in expanded form; e.g., $4.23=(4\times1)+(2\times0.1)+(3\times0.01)$, and showing the relationship of the expanded form to manipulatives and diagrams
  - writing expanded forms as single numbers; e.g., $(4\times1)+(2\times0.1)+(3\times0.01)=4.23$
- rounds whole numbers to the nearest hundred thousand, million, ten million, hundred million
- rounds decimals to the nearest hundredth

Fractions and Decimals

In solving problems, the student demonstrates understanding of proper fraction relationships and relates halves, thirds, quarters and fifths to decimals.

- shows that halves, thirds, quarters and fifths, written as proper fractions or decimals, are equivalent, by making the connection with manipulatives, diagrams, spoken terms, written symbols and the calculator; e.g., $\frac{2}{5}$ is the same as 0.4
- compares proper fractions, halves, thirds, quarters and fifths, with decimals, by making the connection with manipulatives, diagrams and written symbols

Ratio

In solving problems, the student demonstrates understanding of ratio.

- describes the similarities and differences between fractions ($\frac{a}{b}$) and ratios written as fractions ($\frac{a}{b}$), using manipulatives and diagrams
- represents ratios, by:
  - reading and writing ($\frac{a}{b}$, a:b, a to b) from manipulatives and diagrams
  - illustrating spoken terms and written symbols, using manipulatives and diagrams
- explains per cent as a ratio, by making the connection with manipulatives, diagrams, spoken terms and written symbols
- constructs equivalent ratios, including per cent, using manipulatives and diagrams, and makes the connection with spoken terms and written symbols

Integers

In solving problems, the student demonstrates understanding of integers.

- uses integers in real-life applications; e.g., temperature
- represents integers as points on a number line
- orders integers and represents the order, using spoken terms and written symbols, including >, <, =, and verifies correctness with representations on a number line.

OPERATIONS AND PROPERTIES

General Learner Expectations	**Related Specific Learner Expectations**
	In a problem-solving context, the student:
	Addition and Subtraction of Whole Numbers and Decimals
In solving problems, the student demonstrates understanding of addition and subtraction of whole numbers and decimals.	• estimates sums and differences of whole numbers and decimals, using the front-end method; e.g., focus on the front-end amounts: 159 + 232→100 + 200 = 300, rounding, or clustering, such as 596 + 621 + 589 + 610→4x600 = 2400, with compensation
	Multiplication and Division of Whole Numbers and Decimals
In solving problems, the student demonstrates understanding of multiplication and division of whole numbers and division of decimals by whole numbers.	• estimates the products of whole numbers, using the front-end method or rounding, with compensation • multiplies whole numbers, using two-digit multipliers • estimates the quotients of whole numbers, using compatible numbers with compensation • divides two-, three- and four-digit whole numbers, using one- and two- digit divisors • estimates the quotients of decimals, dividends to thousandths, divided by one- and two-digit whole numbers, using compatible numbers with compensation • divides decimals, dividends to thousandths, by one- and two-digit whole number divisors, by: – making the connection between manipulatives and diagrams and a paper and pencil procedure – generating a paper and pencil solution, and verifying correctness with manipulatives and diagrams • shows the relationship between multiplication and division of decimals, using multiplication to check division
	Averages
In solving problems, the student demonstrates understanding of averages.	• estimates and then calculates averages, by: – making the connection between manipulatives and diagrams and a paper and pencil/calculator procedure – generating a paper and pencil/calculator solution, and verifying correctness with manipulatives and diagrams

Appropriate Computational Methods

In solving problems, the student chooses the appropriate calculation methods.

- selects and uses the appropriate calculation methods; e.g., estimation; mental calculation; paper and pencil; calculator, including the memory feature.

MEASUREMENT

General Learner Expectations	Related Specific Learner Expectations

In a problem-solving context, the student:

In solving problems, the student estimates, measures and/or calculates and compares time, length, capacity, mass, perimeter, area, volume and angles (formulas).

Time

- reads the 24-hour clock and writes corresponding standard notation; e.g., bus schedules
- expresses equivalent measures of time; e.g., 2 h 20 min = 140 min

Length

- represents linear measures, by:
  - writing in expanded form; e.g., 154 cm = 1 m +5 dm + 4 cm, and showing the relationship of the expanded form to manipulatives and diagrams
  - writing expanded forms as single numbers with any one of the given units; e.g., 1 m + 5 dm + 4 cm = 154 cm or 15.4 dm or 1.54 m

Capacity

- expresses equivalent measures of capacity (mL, L, kL)

Mass

- expresses equivalent measures of mass (g, kg, t)

Perimeter, Area and Volume

- estimates and finds the perimeter of polygons, by:
  - using manipulatives and diagrams to develop a formula
  - using a formula, and verifying correctness with manipulatives and diagrams
- estimates and finds the area of rectangles, by:
  - using manipulatives and diagrams to develop a formula
  - using a formula, and verifying correctness with manipulatives and diagrams

- estimates and finds the volume of right rectangular prisms, by:
  - using manipulatives and diagrams to develop a formula
  - using a formula, and verifying correctness with manipulatives and diagrams
- shows the relationship between the volume and the dimensions of rectangular solids, by constructing rectangular solids that have the same volume but different dimensions

Angles

- estimates the measure of an angle, measures it, using a protractor, and compares the result with the estimate
- constructs angles, using a protractor
- classifies angles, using the terms: acute, right, obtuse, straight.

Metric Measurement System

- shows that the relationship among the metric prefixes; kilo (k), hecto (h), deca (da), deci (d), centi (c), milli (m), is constant across the basic units (m, L, g)
- shows that the metric measurement system is related to the numeration system; i.e., ten is the basis for both systems

General Learner Expectations

In solving problems, the student constructs circles, uses appropriate terms for lines and parts of a circle, and identifies and draws slides, flips and turns of two-dimensional figures.

Related Specific Learner Expectations

In a problem-solving context, the student:

Classification of Two-dimensional Figures

- uses the terms: intersecting lines, parallel lines

Construction

- constructs a circle, identifies and draws the radius and diameter, and identifies the circumference

Motion Geometry

- identifies and draws translations (slides), reflections (flips) and rotations (turns) of two-dimensional figures, limiting the turn centre to a point on the vertex, edge or centre of the figure.

General Learner Expectations

In solving problems, the student collects, displays and interprets data from a variety of sources and compares experimental results to what should happen in theory.

Related Specific Learner Expectations

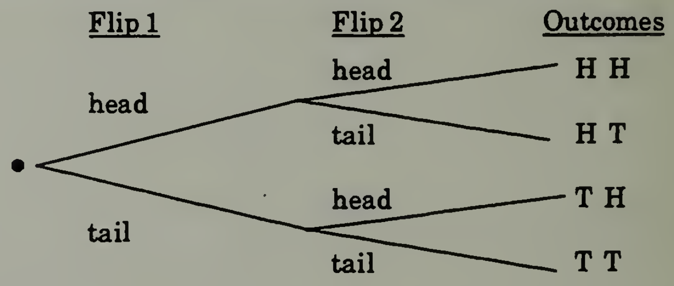
In a problem-solving context, the student:

Collecting and Recording Data

- creates categories for data collection
- collects first-hand information, by:
  - counting objects
  - designing and using questionnaires in conducting polls and surveys
  - conducting experiments
  - using measuring devices
- extracts data from self-researched sources, such as tables, lists, pictures, graphs, books, articles, printed materials
- compares data collected first-hand with data from other sources, such as tables, lists, pictures, graphs, books, articles, printed materials, visual materials
- uses tallies in a chart to record data

Organizing and Displaying Data

- organizes data, using rank ordering; i.e., increasing or decreasing order
- selects and uses class intervals to group information; e.g., the ages of students may be grouped into class intervals of 5 to 9 years, 10 to 14 years, 15 to 19 years
- draws tree diagrams; e.g., a tree diagram could be used in identifying all the possible outcomes in flipping a coin twice:



- constructs single bar graphs, up to 1000 to 1, and justifies the choice of correspondence
- constructs double bar graphs

- graphs and writes coordinates for ordered pairs, first quadrant only
- constructs line graphs
- constructs stem-and-leaf plots; e.g., to organize and display the heights (156 cm, 158 cm, 161 cm, 167 cm, 167 cm) of basketball players, keeping the data intact:

Stem and Leaf Plot

Stem	Leaf
15	6, 8
16	1, 7, 7

15/6 represents 156 cm

Interpreting Displayed Data

- describes data, including data displayed on circle graphs
- compares two probability experiments with common events, using experimental and theoretical data, and identifies which experiment would more likely yield a specified outcome; e.g., choosing a yellow bead from two different sets of yellow and blue beads, if one set has 3 yellow and 2 blue beads, and the other has 4 yellow and 6 blue beads
- uses fractions to describe and connect the probabilities of events from:
  - experimental data
  - theoretical data, which requires the use of all possible outcomes; e.g., the theoretical probability of drawing a red counter from a bag containing 2 red and 3 blue counters is $\frac{2}{5}$
- explains why the probability of:
  - an impossible event is 0
  - an uncertain event is between 0 and 1
  - a certain event is 1
- interprets displayed data to solve problems
- creates new problems from displayed data.

ELEMENTARY MATHEMATICS PROGRAM OF STUDIES

Horizontal Format

Alberta
EDUCATION

Interim October 1994

NUMERATION

Patterns	GRADES Pre-grade 1	1	2	3	4	5	6
In a problem-solving context, the student: ● recognizes and uses patterns by: – identifying a pattern – reproducing a pattern – creating a pattern – extending a pattern	(two or more different actions and manipulatives)	(actions, manipulatives, diagrams, spoken terms, written symbols)					
– translating a pattern from one form to another							
– identifying the similarities and differences among patterns							
● identifies and constructs patterns, by making the connection with manipulatives, diagrams, spoken terms and written symbols; e.g.,		(10s [0 to 100])	(2s, 5s, to 100)				
● identifies and constructs multiples, by making the connection with manipulatives, diagrams, spoken terms, written symbols and a calculator			(100s to 900)	(25s)			
● counts forward and backward from any number by 2s and 5s, by making the connection with manipulatives, diagrams, spoken terms, written symbols and the constant feature of a calculator							
● compares patterns illustrating multiples			(multiples of 10 with multiples of 2, 5 and 100)	(multiples of 5 and 100 with multiples of 25)			
● describes the attributes of odd and even numbers, by making the connection with manipulatives, diagrams, spoken terms, written symbols and the calculator			(0–100)	(0–1000)			

NUMERATION

Whole Numbers, Decimals, Place Value	Pre-grade 1	1	2	3	4	5	6
In a problem-solving context, the student:							
• estimates the number of objects in a set, counts them and compares the result with the estimate		(0–50)	(0–100)	(0–500)	(0–1000)		
• demonstrates understanding of sets by:							
– sorting objects into sets according to attributes and describing these attributes	—						
– matching members of two sets of manipulatives, and describing the relationship between the two sets, using the terms more than, greater than, fewer than, less than, the same as/equal to (no written symbols)	—						
– creating at least two different ways of sorting objects		—					
– matching two sets of manipulatives or diagrams, and describing the relationship between the two sets, using more than, less than, greater than, fewer than, the same as/equal to (no written symbols)		—					
• describes a number, using different arrangements and combinations of objects within a set; e.g., 6 is one more than 5, 2 groups of 3, 3 groups of 2, 1 group of 4 and 1 group of 2		(0–10)	(0–100)				
• represents numbers, by:							
– creating sets, using manipulatives and diagrams, and making the connection with their spoken terms and written symbols	—						
– illustrating spoken terms and written symbols, using manipulatives and diagrams							
– reading and writing from manipulatives and diagrams							
– illustrating spoken terms and written symbols, using manipulatives and diagrams		(0–100)	(0–999)				
– reading and writing symbols; e.g., 1352, and number words; e.g., one thousand three hundred fifty-two, from manipulatives and diagrams				—	⋯	⋯	⋯
– illustrating spoken terms, written symbols and number word forms, using manipulatives and diagrams							

NUMERATION

	GRADES						
Whole Numbers, Decimals, Place Value (continued)	Pre-grade 1	1	2	3	4	5	6
● counts the number of objects in a set	(1–9)	(0–100 groups of 10)					
● reads, writes and orders whole numbers and decimals, by making the connection with manipulatives, diagrams, spoken terms and written symbols					(hundreds to ten thousands)	(thousandths to hundred thousands	(thousandths to billions)
● describes the relationship among place values, including regrouping, by making the connection with manipulatives, diagrams, spoken terms and written symbols			(1s, 10s, 100s)	(tenths to thousands)	(hundredths to ten thousands)	(thousandths to hundred thousands)	(thousandths to billions)
● constructs equivalent decimals, tenths and hundredths, using manipulatives and diagrams, and by making the connection with spoken terms and written symbols					—		
● generates equivalent decimals in symbolic form, and verifies their equivalence, using manipulatives and diagrams						—	……
● identifies and names the place value of digits, by making the connection with manipulatives, diagrams, spoken terms and written symbols			(0–999)	(tenths to thousands)	(hundredths to ten thousands)	(thousandths to hundred thousands)	(thousandths to billions)
● represents numbers by: – writing in expanded form and showing the relationship of the expanded form to manipulatives and diagrams – writing expanded forms as single numbers				(0–9 999)	(0–99 999)	(0–999 999)	(thousandths to billions)
● represents the order of numbers, by: – ordering sets, based on the number of objects in the sets – sequencing sets of manipulatives or diagrams, and making the connection with their spoken terms and written symbols – using spoken terms and written symbols, and verifying correctness with manipulatives and diagrams	—	(0–10)	(0–100)	(0–1000)			
● describing the relationship between two numbers, using the terms: greater than, less than, equal to and their symbols (>, <, =)				—	……	……	……

NUMERATION

	GRADES						
	Pre-grade 1	1	2	3	4	5	6
Whole Numbers, Decimals, Place Value (continued)							
● names and uses ordinal numbers (numbers that denote order of the members of a set) first to tenth, by making the connection with manipulatives, diagrams, spoken terms and written symbols			(first to tenth)	(first to hundredth)	……	……	……
● rounds whole numbers by making the connection with manipulatives, diagrams, spoken terms and written symbols					(limit: to the nearest thousand)	(limit: to the nearest ten thousand)	(limit: to the nearest hundred million)
● rounds decimals by making the connection with manipulatives, diagrams, spoken terms and written symbols					(limit: to the nearest whole number)	(limit: to the nearest tenth or hundredth)	(limit: to the nearest hundredth)
Fractions and Decimals							
In a problem-solving context, the student: ● represents a proper fraction that describes one of two equal parts of a region, by: – making the connection between manipulatives and diagrams and the spoken term one half – illustrating the spoken term one half, using manipulatives and diagrams		—					
● represents proper fractions that describe equal parts of a region or group, by: – reading and writing from manipulatives and diagrams – illustrating spoken terms and written symbols, using manipulatives and diagrams			(halves, thirds, quarters)	(fifths, tenths)	(100ths)	……	……
● shows that numbers, written as proper fractions or as decimals are equivalent, by making the connection with manipulatives, diagrams, spoken terms and written symbols				(tenths)	(hundredths)	(thousandths)	……

NUMERATION

GRADES

Fractions and Decimals (continued)	Pre-grade 1	1	2	3	4	5	6
● constructs equivalent proper fractions, halves, thirds, quarters, fifths, tenths and hundredths, using manipulatives and diagrams, and makes the connection with spoken terms and written symbols					—	…	…
● generates equivalent fractions, halves, thirds, quarters, fifths, tenths and hundredths, in symbolic form, and verifies their equivalence, using manipulatives and diagrams						—	…
● represents halves, thirds, quarters, fifths, tenths and hundredths as points on a number line					—	…	…
● compares proper fractions, represented by manipulatives and diagrams, using the terms: greater than, less than, equal to, and their symbols (>, <, =)					—		
● compares proper fractions, halves, thirds, quarters, fifths, tenths and hundredths, by generating equivalent fractions, and verifies correctness, using manipulatives and diagrams						—	
● compares proper fractions, halves, thirds, quarters and fifths, with decimals, by making the connection with manipulatives, diagrams and written symbols							—
● shows that halves, thirds, quarters and fifths, written as proper fractions or decimals, are equivalent, by making the connection with manipulatives, diagrams, spoken terms, written symbols and the calculator							—

NUMERATION

	GRADES						
	Pre-grade 1	1	2	3	4	5	6
Ratio							
In a problem-solving context, the student: ● describes the similarities and differences between fractions ($\frac{a}{b}$) and ratios written as fractions ($\frac{a}{b}$), using manipulatives and diagrams							—
● represents ratios, by: – reading and writing ($\frac{a}{b}$, a:b, a to b) from manipulatives and diagrams – illustrating spoken terms and written symbols, using manipulatives and diagrams							—
● explains per cent as a ratio, by making the connection with manipulatives, diagrams, spoken terms and written symbols							—
● constructs equivalent ratios, including per cent, using manipulatives and diagrams, and makes the connection with spoken terms and written symbols							—
Integers							
In a problem-solving context, the student: ● uses integers in real-life applications; e.g., temperature							—
● represents integers as points on a number line							—
● orders integers and represents the order, using spoken terms and written symbols, including >, <, =, and verifies correctness with representations on a number line							—

OPERATIONS AND PROPERTIES

	GRADES						
	Pre-grade 1	1	2	3	4	5	6
Addition and Subtraction of Whole Numbers							
In a problem-solving context, the student: ● represents the processes of addition and subtraction through role playing and the use of manipulatives	——						
● shows the process of addition, putting two sets together, using manipulatives and diagrams		——					
● shows the process of subtraction; taking away, missing addend, comparison, using manipulatives and diagrams		——					
● adds and subtracts numbers to 10, by:							
– making the connection with manipulatives, spoken terms and the written symbols		——					
– illustrating spoken terms and written symbols, using manipulatives and diagrams		——					
● applies addition and subtraction facts to 18, using manipulatives, diagrams, doubles, tens, when adding or subtracting eights or nines			——				
● recalls, without hesitation, addition and subtraction facts		(to 5)	(to 10)	(to 18)	……	……	……
● adds and subtracts, without hesitation, using 0 and 1		——					
● calculates, mentally, by counting forward and backward from a given number		——					
● estimates sums and differences, by using:			(sums and minuends to 99)	(limit: three-digit numbers)	(limit: four-digit numbers)	(limit: five-digit numbers)	(any whole numbers)
– the front-end method				——	——	——	——
– rounding					——	——	——
– clustering							——

OPERATIONS AND PROPERTIES

	GRADES						
	Pre-grade 1	1	2	3	4	5	6
Addition and Subtraction of Whole Numbers (continued)							
● adds and subtracts with and without regrouping, by: – making the connection between manipulatives and diagrams and a paper and pencil procedure – generating a paper and pencil solution, and verifying correctness with manipulatives and diagrams			(sums and minuends to 99)	(any two- and three-digit numbers)	(limit: four-digit numbers)	······	······
● calculates, mentally, using trailing zeros, when adding or subtracting multiples of 10			——	······	······	······	······
● calculates, mentally, using compatible numbers when adding or subtracting				——	······	······	······
● calculates, mentally, using the left to right method						——	······
● shows the relationship between addition and subtraction, by:							
– making the connection between manipulatives and diagrams and related number sentences				——	······	······	······
– generating related number sentences, and verifying correctness with manipulatives and diagrams				——	······	······	······
– using addition to check subtraction					——	······	······
Multiplication and Division of Whole Numbers							
In a problem-solving context, the student: ● shows the process of multiplication, using manipulatives and diagrams (no written number sentences)			——				
● shows the process of division, equal sharing and repeated subtraction of equal groups, using manipulatives and diagrams (no written number sentences)			——				

OPERATIONS AND PROPERTIES

	GRADES						
	Pre-grade 1	1	2	3	4	5	6
Multiplication and Division of Whole Numbers (continued)							
• multiplies and divides numbers, by:							
– making the connection among manipulatives and diagrams, spoken terms and written symbols				(to 45)	(to 81)		
– illustrating spoken terms and written symbols, using manipulatives and diagrams						⋯	⋯
• recalls, without hesitation, multiplication and division facts					(to 81)	⋯	⋯
• multiplies one-digit whole numbers, mentally, by 10 and 100, and explains why the answer is correct				—			
• calculates, mentally, to multiply:							
– whole numbers by 10, 100 and 1000					—	⋯	⋯
– multiples of 10, 100 and 1000					—	⋯	⋯
• multiplies and divides whole numbers, mentally, by 10, 100 and 1000, and explains why the answer is correct						—	⋯
• finds all the factors of whole numbers, by making the connection with manipulatives, diagrams, spoken terms and written symbols						(limit: two-digit numbers)	⋯
• estimates products, using the front-end method or rounding with compensation					(two and three digits by one digit)	(limit: two-digit multipliers)	⋯
• multiplies whole numbers, by: – making the connection between manipulatives and diagrams and a paper and pencil procedure – generating a paper and pencil solution, and verifying correctness with manipulatives and diagrams					(two and three digits by one digit)	(limit: two-digit multipliers)	⋯
• estimates quotients of two-digit whole numbers and one-digit divisors, using compatible numbers					(two digits by one digit)	(two, three or four digits by one digit)	(any whole numbers)

OPERATIONS AND PROPERTIES

	GRADES						
	Pre-grade 1	1	2	3	4	5	6
Multiplication and Division of Whole Numbers (continued)							
• shows the relationship between multiplication and division, by:							
– making the connection between manipulatives and diagrams and related number sentences				━	┈	┈	┈
– generating related number sentences, and verifying correctness with manipulatives and diagrams				━	┈	┈	┈
– using multiplication to check division					━	━	┈
• divides whole numbers, with and without remainders, by: – making the connection between manipulatives and diagrams and the paper and pencil procedure – generating a paper and pencil solution, and verifying correctness with manipulatives and diagrams					(one and two digits by one digit)	(one, two, three and four digits by one digit)	(two, three and four digits by one and two digits)
Properties of Operations							
In a problem-solving context, the student: • shows the commutative property of addition, using manipulatives and diagrams		━					
• describes the commutative property of addition represented by manipulatives and diagrams			━				
• describes the commutative property of addition and multiplication, by making the connection with manipulatives, diagrams, spoken terms and written symbols				━	┈	┈	┈
• describes the unique effect of 0 in addition, and 1 in multiplication, by making the connection with manipulatives, diagrams, spoken terms and written symbols				━	┈	┈	┈
• describes the commutative and associative properties of addition and multiplication, by making the connection with manipulatives, diagrams, spoken terms and written symbols					━	┈	┈

OPERATIONS AND PROPERTIES

	GRADES						
	Pre-grade 1	1	2	3	4	5	6
Properties of Operations (continued)							
• applies the commutative and associative properties in mental calculation by searching for compatible numbers					——	······	······
• describes the distributive property, by making the connection with manipulatives, diagrams, spoken terms and written symbols					——	······	······
• applies the distributive property in mental calculation					——	······	······
Addition and Subtraction of Decimals							
In a problem-solving context, the student: • estimates sums and differences of decimals, by using the front-end method; or rounding to the nearest whole number with compensation					(to hundredths)	(to thousandths)	——
• adds and subtracts decimals, by: – making the connection between manipulatives and diagrams and a paper and pencil procedure					(to hundredths)	(to thousandths)	······
– generating a paper and pencil solution, and verifying correctness with manipulatives and diagrams							······
• shows the relationship between the addition and subtraction of decimals, using addition to check subtraction					——	——	······
Multiplication and Division of Decimals							
In a problem-solving context, the student: • multiplies and divides decimals, mentally, by 10, 100 and 1000, and explains why the answer is correct						——	······
• estimates products of decimals multiplied by whole numbers, using the front-end method or rounding with compensation						——	······

OPERATIONS AND PROPERTIES

	GRADES						
	Pre-grade 1	1	2	3	4	5	6
Multiplication and Division of Decimals (continued)							
● multiplies decimals, multiplicands to thousandths, by one- and two-digit whole number multipliers, by: – making the connection between manipulatives and diagrams and a paper and pencil procedure – generating a paper and pencil solution, and verifying correctness with manipulatives and diagrams						—	……
● estimates quotients of decimals, divided by whole numbers, using compatible numbers with compensation						(dividends to hundredths, one-digit divisors)	(dividends to thousandths, one- and two-digit divisors)
● divides decimals by whole number divisors, by: – making the connection between manipulatives and diagrams and a paper and pencil procedure – generating a paper and pencil solution, and verifying correctness with manipulatives and diagrams						(dividends to hundredths, one-digit divisors)	(dividends to thousandths, one- and two-digit divisors)
● shows the relationship between multiplication and division of decimals, using multiplication to check division						—	—
Using Appropriate Terms							
In a problem-solving context, the student: ● uses the terms: sum, difference, factor, product, divisor, dividend, quotient						—	……
Averages							
In a problem-solving context, the student: ● estimates and then calculates averages, by: – making the connection between manipulatives and diagrams and a paper and pencil/calculator procedure – generating a paper and pencil/calculator solution, and verifying correctness with manipulatives and diagrams							—

OPERATIONS AND PROPERTIES

	GRADES						
	Pre-grade 1	1	2	3	4	5	6
Appropriate Computational Methods							
In a problem-solving context, the student: ● selects and uses appropriate calculation methods			(addition and subtraction)	(the four operations, whole numbers)	(the four operations, whole numbers and decimals)	(the memory feature of the calculator)	

MEASUREMENT

Time	GRADES						
	Pre-grade 1	1	2	3	4	5	6
In a problem-solving context, the student:							
● recognizes terms expressing the passage of time: now, not now, before, after, long time, short time, yesterday, today, tomorrow	———						
● uses terms expressing the passage of time: before, after, long time, short time, yesterday, today, tomorrow		———					
● uses terms to indicate that time is divided into parts		———					
● associates the position of the hands on an analog clock, or the display of numbers on a digital clock, with familiar activities		———					
● estimates and reads time, to the nearest hour, for analog and digital clocks		———					
● estimates, reads and writes time using standard notation for both analog and digital clocks			(hour, half hour, quarter hour)	(5-minutes)	(minutes)	(seconds)	……
● uses a clock to identify the resulting time when adding or subtracting time intervals				———	……	……	……
● reads the 24-hour clock and writes corresponding standard notation							———
● recites and orders the days of the week		———	……	……	……	……	……
● reads dates on a calendar			———	……	……	……	……
● recites the months of the year in order			———	……	……	……	……
● orders the months of the year				———	……	……	……
● expresses equivalent measures of time							———

MEASUREMENT	GRADES						
	Pre-grade 1	1	2	3	4	5	6
Length							
In a problem-solving context, the student:							
● uses the terms: big,small, tall, long, short	———						
● compares and orders two or more objects according to length, height and thickness	———						
● uses non standard units for measuring length	———						
● estimates, measures, compares and orders length		(nonstandard units)	(cm, m)	(cm, dm, m, km)	(mm, cm, dm, m, km)	……	……
● selects and uses standard units for measuring length					———	……	……
● expresses equivalent linear measures, by making the connection with manipulatives, diagrams, spoken terms and written symbols						(mm, cm, dm, m, km)	……
● expresses linear measure to the nearest tenth, hundredth and thousandth of a metre, by making the connection with manipulatives and diagrams to spoken terms and written symbols						———	……
● represents linear measures, by: – writing in expanded form, and showing the relationship of the expanded form to manipulatives and diagrams – writing expanded forms as single numbers with any one of the given units							———
Capacity							
In a problem-solving context, the student:							
● uses the terms: empty, full	———						
● uses nonstandard units for measuring capacity	———						
● estimates and measures capacity, using nonstandard units		———	……				
● estimates, measures, compares and orders capacity, using standard units with symbols				———	……	……	……

MEASUREMENT

	GRADES						
	Pre-grade 1	1	2	3	4	5	6
Capacity (continued)							
● compares the amount/capacity as more than, less than, the same as, using:							
– two identical containers	―						
– any two containers		―					
– two or more containers, with units of measure			(nonstandard units)	(mL, L)	⋯	⋯	⋯
● selects and uses standard units for measuring capacity					(mL, L)	(mL, L, kL)	⋯
● expresses equivalent measures of capacity							(mL, L, kL)
Mass							
In a problem-solving context, the student:							
● uses the terms: heavy, light	―						
● uses nonstandard units for measuring mass	―						
● estimates and measures mass, using nonstandard units		―	⋯				
● estimates, measures, compares and orders mass, using standard units with symbols				―	⋯	⋯	⋯
● compares mass as heavier than, lighter than, the same as, using:							
– two objects, with	(hands)	(balance scale)					
– two or more objects, with units of measure			(nonstandard units)	(g, kg)	⋯	⋯	⋯
● selects and uses standard units for measuring mass					(g, kg)	(g, kg, t)	⋯
● expresses equivalent measures of mass							(g, kg, t)
Temperature							
In a problem-solving context, the student:							
● uses the terms: hot, cold	―						

MEASUREMENT	GRADES						
	Pre-grade 1	1	2	3	4	5	6
Temperature (continued)							
• compares two or more objects as hotter than, colder than, the same as, and puts objects in order according to their temperature	—						
• examines two or more Celsius thermometers, and compares temperatures as hotter than or colder than		—					
• estimates temperature, reads the Celsius thermometer to one degree intervals, and uses the symbol °C			—	·····	·····	·····	·····
• reads a Celsius thermometer, and determines the reasonableness of readings in given situations					—	·····	·····
Money							
In a problem-solving context, the student: • recognizes that purchasing involves an exchange of money or tokens for goods or services	—	·····					
• recognize and states the value of pennies, nickels, dimes, quarters and dollar coins		—					
• gives equivalent value of coins up to and including 10 cents		—					
• estimates and counts collections of coins up to and including $1, using dimes and pennies		—					
• estimates amounts, counts collections, give equivalent value of coins (dimes, nickels, pennies), by making the connection with manipulatives , diagrams, spoken terms and written symbols			($1, using dimes, nickels, pennies)	($5, using any coin and appropriate bills)	(limit: $9999)		
• makes purchases, by making the connection with manipulatives, diagrams, spoken terms and written symbols			($1)	($5)			·····
• makes purchases and change				($5)	($9999)	(any amount)	·····

MEASUREMENT

	GRADES						
	Pre-grade 1	1	2	3	4	5	6
Perimeter, Area and Volume							
In a problem-solving context, the student: ● estimates, finds and compares perimeter, by making the connection with manipulatives, diagrams, spoken terms and written symbols (no formulas)					(rectangles)	(polygons)	
● estimates and finds the perimeter of polygons, by: – using manipulatives and diagrams to develop a formula – using a formula, and verifying correctness with manipulatives and diagrams							—
● estimates, finds and compares area, by making the connection with manipulatives, diagrams, spoken terms and written symbols (no formulas)					(rectangles with nonstandard units)	(polygons with standard units)	
● estimates and finds the area of rectangles, by: – using manipulatives and diagrams to develop a formula – using a formula, and verifying correctness with manipulatives and diagrams							—
● shows the relationship between perimeter and area, using manipulatives and diagrams to: – construct rectangles that have the same perimeter but different areas – construct rectangles that have the same area but different perimeters						—	……
● estimates, finds and compares the volume of right rectangular prisms, by making the connection with manipulatives, diagrams, spoken terms and written symbols (no formulas)						—	
● estimates and finds the volume of right rectangular prisms, by: – using manipulatives and diagrams to develop a formula – using a formula, and verifying correctness with manipulatives and diagrams							—

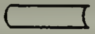
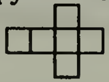
MEASUREMENT

	GRADES						
	Pre-grade 1	1	2	3	4	5	6
Perimeter, Area and Volume (continued)							
● shows the relationship between the volume and the dimensions of rectangular solids, by constructing rectangular solids that have the same volume but different dimensions							▬
Angles							
In a problem-solving context, the student: ● estimates the measure of an angle, measures it, using a protractor, and compares the result with the estimate							▬
● constructs angles, using a protractor							▬
● classifies angles, using the terms: acute, right, obtuse, straight							▬
Metric Measurement System							
In a problem-solving context, the student: ● shows the relationship among the metric prefixes; kilo (k), hecto (h), deca (da), deci (d), centi (c), milli (m), is constant across the basic units (m, L, g)							▬
● shows that the metric measurement system is related to the numeration system; i.e., ten is the basis for both systems							▬

GEOMETRY

	GRADES						
	Pre-grade 1	1	2	3	4	5	6
Spatial Relationships							
In a problem-solving context, the student:							
● recognizes spatial relationships: inside, outside, in front of, behind, on, under, up, down, here, there, over, above, below, between, near	—						
● describes spatial relationships, using the terms: inside, outside, in front of, behind, on, under, up, down, here, there, over, above, below, between, near		—	···	···	···	···	···
Patterns							
In a problem-solving context, the student:							
● uses three-dimensional objects from the real world to: – identify patterns – reproduce patterns – create patterns – extend patterns	—						
● translates a pattern from one form to another; e.g., manipulatives diagrams, spoken terms, written symbols		—	···	···	···	···	···
● identifies the similarities and differences among patterns		—	···	···	···	···	···
Classification of Three-dimensional Objects and Two-dimensional Figures							
In a problem-solving context, the student:							
● classifies three-dimensional objects from the real world							
– using the terms: balls, boxes, cans, cones	—						
– creating at least two different ways of sorting the objects		—	···	···	···	···	···
– describing the attributes used in sorting; e.g., objects could be classified as balls, cones or boxes; or as objects that roll or do not roll		—	···	···	···	···	···
– relating objects in the real world to models of spheres, cylinders, cones, prisms, pyramids			—	···	···	···	···
– identifying vertices, edges, faces and curved surfaces			—	···	···	···	···

GEOMETRY

	GRADES						
	Pre-grade 1	1	2	3	4	5	6
Classification of Three-dimensional Objects and Two-dimensional Figures (continued)							
● classifies and names two-dimensional figures as circles, squares, triangles or rectangles, by:							
– using objects from the real world		—					
– using diagrams of each type that include a wide variety of sizes, shapes and positions		—					
– using sets, including types other than circles, squares, triangles or rectangles; e.g., ovals, figures, that contain four sides or more than four sides		—					
– tracing the faces of three-dimensional objects			—	···	···	···	···
– using sets, other than those described; e.g., figures with sides and curves 			—	···	···	···	···
– identifying the corners (vertices), sides and curves			—	···	···	···	···
– describing the essential attributes of squares, triangles and rectangles; e.g., a rectangle is a four-sided figure with four square corners				—	···	···	···
– describing the relationship among squares, rectangles and triangles; e.g., similarities, differences, all squares are rectangles				—	···	···	···
● classifies and names two-dimensional figures, using the terms: circles, triangles, squares, rectangles, pentagons, hexagons, octagons						—	···
● relates three-dimensional objects to two-dimensional figures, by connecting nets with objects and naming them as cylinders, cones, prisms or pyramids; e.g., the net for a cube could be 					—	···	···

GEOMETRY

	GRADES						
	Pre-grade 1	1	2	3	4	5	6
Classification of Three-dimensional Objects and Two-dimensional Figures (continued)							
● classifies three-dimensional objects by:							
– naming them, using the terms: spheres, cylinders, cones, prisms, pyramids				━	···	···	···
– describing the attributes of prisms, pyramids, cones, cylinders and spheres						━	···
– naming prisms and pyramids, by identifying the shape of the base, using objects or nets						━	···
● uses the terms: line segment, line, ray, angle						━	
● uses the terms: intersecting lines, parallel lines							━
Construction							
In a problem-solving context, the student:							
● constructs three-dimensional objects, prisms and spheres, using straws, pipe cleaners, moulding clay				━			
● constructs three-dimensional objects, cylinders, cones prisms, pyramids, using nets					━	···	···
● constructs two-dimensional figures, 3, 4, 5, 6 and 8 sides, using toothpicks, geoboards				━	···	···	···
● constructs a circle, identifies and draws the radius and diameter, and identifies the circumference							━
Symmetry and Motion Geometry							
In a problem-solving context, the student:							
● identifies symmetrical objects in the real world		━					
● creates and verifies symmetrical figures by folding and/or cutting			━	···	···	···	···
● identifies two-dimensional figures as symmetrical, by drawing lines of symmetry				━	···	···	···

GEOMETRY

	GRADES						
	Pre-grade 1	1	2	3	4	5	6
Symmetry and Motion Geometry (continued)							
● translates (slides) and reflects (flips) objects, and records their positions, by tracing the face of each object					———	……	……
● identifies and draws translations (slides) and reflections (flips) of two-dimensional figures						———	……
● rotates (turns) objects on a vertex, edge or centre, and records their positions, by tracing the face of each object						———	……
● identifies and draws translations (slides), reflections (flips) and rotations (turns) of two-dimensional figures, limiting the turn centre to a point on the vertex, edge or centre of the figure							———

DATA MANAGEMENT

	GRADES						
	Pre-grade 1	1	2	3	4	5	6
Collecting and Recording Data							
In a problem-solving context, the student: ● creates categories for data collection	(two categories, extending to more than two) (teacher guided)	(two or more categories)	—	—	—	—	—
● collects first-hand information, by							
– counting objects	—	—	—	—	—	—	—
– conducting polls and surveys	—	—	—	—	—	—	—
– conducting experiments		—	—	—	—	—	—
– using measuring devices		(nonstandard units)	(cm, m)	(cm, dm, m, km, mL, L, g, kg)	(mm, cm, dm, m, km, mL, L, g, kg)	—	—
– designing and using questionnaires in conducting polls and surveys							—
● extracts data from sources, such as tables, lists, pictures, graphs, books, articles, printed materials, visual materials							
– given				—	—	—	—
– self-researched						—	—
● compares data collected first-hand with data from other sources, such as tables, lists, pictures, graphs, books, articles, printed materials, visual materials						—	—
● uses tallies to record data			—				
● uses tallies in a chart to record data				—	—	—	—

DATA MANAGEMENT

	GRADES						
	Pre-grade 1	1	2	3	4	5	6
Organizing and Displaying Data							
In a problem-solving context, the student:							
● organizes data:							
– uses rank ordering				———	———	———	———
– uses class intervals to group information					———		
– selects and uses class intervals to group information						———	———
– draws tree diagrams							———
● constructs graphs							
– concrete/object graphs	(1 to 1) (teacher guided)	(1 to 1)	(1 to 1)				
– pictographs		(1 to 1)	(1 to 1)	(2 to 1, 5 to 1, 10 to 1)	(100 to 1)	········	········
– bar graphs			(1 to 1)	(2 to 1, 5 to 1, 10 to 1)	(2 to 1, 5 to 1, 10 to 1, 100 to 1)	(1000 to 1)	········
– double bar graphs							———
– justifies the choice of correspondence for graphs					———	———	———
– labels and titles on graphs		discusses the purpose	writes	········	········	········	········
– places an object on a grid, using columns and rows				———			
– describes the position of an object on a grid, referring to columns and rows				———			
– graphs and writes coordinates for ordered pairs, first quadrant only					———	———	———
– line graphs						———	———
– stem and leaf plots						———	———
● displays data in two different ways; e.g., pictograph, bar graph				———	········	········	········

DATA MANAGEMENT

	GRADES						
	Pre-grade 1	1	2	3	4	5	6
Organizing and Displaying Data (continued)							
● describes the similarities and differences between data displayed in different ways; e.g., pictograph, bar graph					▬	⋯	⋯
● distinguishes among types of graphs, and discusses reasons for using each type of graph						▬	⋯
Interpreting Displayed Data							
In a problem-solving context, the student:							
● describes data, by:							
– comparing data in two or more categories, using the terms, greater than, more than, less than, fewer than, the same as	▬						
– using the terms: more than, greater than, less than, the same as, fewer, most, least, altogether, how many fewer, how many more, equal to		▬					
– using fractions, with the emphasis on halves, thirds, quarters, fifths, tenths and hundredths					▬	⋯	⋯
– interpreting data displayed on circle graphs							▬
● describes the chance of certain events happening (probability), using the terms:							
– never, sometimes, always		▬					
– never, sometimes, always, probably, likely, unlikely, more likely, less likely			▬	⋯	⋯	⋯	⋯
● identifies events as:							
– impossible, uncertain or certain				▬	⋯	⋯	⋯
– equally likely, more likely or less likely					(limit: 2 events)	(2 or more events)	⋯
● creates situations to exemplify events as impossible, uncertain, certain, equally likely, more likely or less likely						▬	⋯

DATA MANAGEMENT

	GRADES						
	Pre-grade 1	1	2	3	4	5	6
Interpreting Displayed Data (continued)							
• conducts two probability experiments with common events, and identifies which experiment would more likely yield a specified outcome; e.g., choosing a yellow bead from two different sets of yellow and blue beads, if one set has 3 yellow and 2 blue beads, and the other has 4 yellow and 6 blue beads						(experi-mental data)	(theoretical data)
• uses fractions to describe and connect the probabilities of events from: – experimental data – theoretical data, which requires the use of all possible outcomes; e.g., the theoretical probability of drawing a red counter from a bag containing 2 red and 3 blue counters is $\frac{2}{5}$							— —
• explains why the probability of: – an impossible event is 0 – an uncertain event is between 0 and 1 – a certain event is 1							—
• interprets data to solve problems	—						
• interprets displayed data to solve problems		—	—	—	—	—	—
• creates new problems from displayed data	(one)	(more than one)	—	—	—	—	—

ELEMENTARY MATHEMATICS PROGRAM OF STUDIES GLOSSARY

Interim
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EDUCATION

ELEMENTARY MATHEMATICS GLOSSARY

This glossary explains mathematical terms used in the Program of Studies. It is organized by the strands of the elementary mathematics program:

- Numeration
- Operations and Properties
- Measurement
- Geometry
- Data Management.

Terms used across strands are referenced only once in the strand in which they first occur.

NUMERATION

Attributes	Characteristics of figures that allow them to be sorted, classified.
Constant Feature of a Calculator	A feature of the basic four-function calculator that allows a person to add, subtract, multiply or divide a number repeatedly.
Decimal	Any numeral in the decimal number system (i.e., a system of numerals for representing real numbers that uses base 10). Example: 1.5 and 0.6 are decimals.
Integers	Includes the whole numbers and their opposites. . . . , -4, -3, -2, -1, 0, 1, 2, 3, 4
Ordinal Numbers	Numbers that denote the order of the members of a set as well as how many members there are in the set. Example: * & $ # The dollar sign is the third symbol from the left. (Third is an ordinal number because it denotes the order of the dollar sign symbol as well as how many symbols are in the set to the left of and including the dollar sign.)
Pattern	A repeated sequence or arrangement about which predictions can be made.
Place Value	The value given to a digit by virtue of the place it occupies in the number relative to the units place. e.g., in 436, **6** denotes 6 units, **3** denotes 30 units, and **4** denotes 400 units.
Proper Fraction	The fraction in which the numerator is less than the denominator and has the context of part over whole. Example: $\frac{3}{4}$ is a proper fraction; 3 is the numerator and 4 is the denominator.
Ratio	A comparison of two quantities with the same unit of measure. Example: In a set of 3 red marbles and 4 blue marbles the ratio of the number of red marbles to the number of blue marbles is 3 to 4 or 3 : 4 or $\frac{3}{4}$.

Set	A collection of particular objects, with clearly defined characteristics that determine whether each object is a member of the set.

OPERATIONS AND PROPERTIES

DIVISION

• **Dividend**	The number which is being divided. Example: $42 \div 7 = 6$; 42 is the dividend, 7 is the divisor and 6 is the quotient.
• **Divisor**	The number that divides into another number. Example: $42 \div 7 = 6$; 42 is the dividend, 7 is the divisor and 6 is the quotient.
• **Equal Grouping**	The process of division in which a given number of items is repeatedly taken away from a given quantity. The number of equal groups taken away is the answer to the division problem. Example: You have 24 pictures to paste into a book. If 4 pictures fit on one page, how many pages will be needed for the pictures? Ask yourself "*In 24, there are how many groups of 4?*" Repeatedly remove 4 objects from a group of 24 objects until you can no longer remove a complete set of 4 objects. □□□□ □□□□ □□□□ □□□□ □□□□ □□□□ Answer: You would need 6 pages.
• **Equal Sharing**	The process of division in which a given quantity is separated into a given number of groups so that each of the groups has the same number of items. The number of items in each of the groups is the answer to the division problem. Example: You have 12 cookies to give to three children. Each child is to get the same number of cookies. How many cookies does each child get? Ask yourself "*In 12 there are three groups of how many?*" Place 12 objects into 3 groups by putting one object into each of the 3 groups, then another into each of the 3 groups and so on until all 12 objects are distributed evenly. ○○○○ ○○○○ ○○○○ Answer: Each child would get 4 cookies.
• **Quotient**	The answer to a division problem. Example: $42 \div 7 = 6$. 42 is the dividend, 7 is the divisor and 6 is the quotient.

ESTIMATION AND MENTAL CALCULATION STRATEGIES

• **Clustering Strategy**	A method for estimating the sum of a list of numbers that are close to each other in value. Example: A magazine production for three days is 38 532, 39 928 and 41 123. About how many magazines were produced for these three days? The numbers are all close in value to 40 000. 3×40 000=120 000. Answer: About 120 000 magazines were produced for the three days.
• **Compatible Numbers Strategy**	An estimation or mental calculation method using numbers that "fit together" and are easy to manipulate mentally. Estimation example: $3 388 is to be divided evenly among 7 people. About how much money should each person receive? 3 500 ÷ 7 are compatible numbers because the quotient, which is 500, can be determined mentally. Answer: Each person should receive about $500. Mental Calculation example: You have 36 stickers and your friend has 59 stickers. How many stickers do you and your friend have all together? 36+59=35+60=95 Answer: We have 95 stickers.
• **Compensation**	Used with calculation estimation strategies to refine the estimation. Example: You buy a hamburger for $4.79, a drink for $1.26 and a cone for $0.95. Will $6 cover the cost? Refine the front-end estimate of $5 ($4+$1=$5) by grouping the cent amounts to form dollars: $0.26 and $0.79 makes about $1 $0.95 is about $1 total compensation: $2 Refined estimate including front-end with compensation: $5+$2=$7 No, $6 will not cover the cost.
• **Estimation**	A process of simplifying information related to a problem so that calculations can be done mentally to arrive at an approximate answer. Example: Weekly spending money of $2.25 would be estimated as just over ($2×50)=$100 for the year, taking $2.25 as just over $2 and 50 as just under 52.

Front-end Strategy	A method for estimating an answer to a calculation problem by focusing on the "front-end" or "left-most" digits of a number. Its strongest application is for addition. Example: You buy a hamburger for $4.79, a drink for $1.26 and a cone for $0.95. Will a $5 bill cover the cost? Total the front-end (dollar) amounts: $4 + $1 = $5. Answer: No, a $5 bill will not cover the cost because the front-end estimate which is always an underestimate is $5.
Memory Features of a Calculator	This feature allows numbers or the results of calculations to be stored for later use.
Mental Calculation	A process of completing simple calculations in a single step, with only the final answer recorded. These mental calculations are of two types, exact answers to extremely simple questions, such as the multiplication or division of two digit numbers by single digit numbers, or approximate answers to more complex problems, such as replacing the United States by a rectangle before computing the area.
Rounding	Reexpressing an exact number to the nearest unit, 10, 100, etc., for ease of calculation and to produce an approximate answer. Example: If 29 students each had 5 pencils, how many pencils would they have altogether? The exact answer would be 29×5=145. The rounded answer would be 30×5=150.

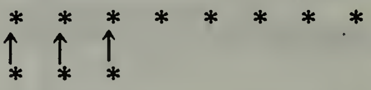
MULTIPLICATION

Factor	A number that is multiplied by another number to make a product. Example: 3×2=6, therefore, 2 and 3 are factors of 6.
Multiplicand	The number to be multiplied by another number, called the multiplier. Example: multiplicand → 8 multiplier → ×7 product → 56
Product	The answer to a multiplication problem. Example: 7×6=42. 7 is the multiplicand, 6 is the multiplier and 42 is the product.

PROPERTIES OF OPERATIONS

Associative Property	When three or more numbers are added or multiplied, the operations may be performed in any order. Example for addition: in adding $2+8+4$, the answer is the same if you add 2 to 8 first and then 4 or if you add 2 to the sum of 8 and 4. Example for multiplication: in multiplying $2\times 8\times 5$, the answer is the same if you multiply 2 and 8 first and then multiply by 5 or if you multiply 2 by the product of 8 and 5.
Commutative Property	When two numbers are added or multiplied, the operation may be performed in any order. Example for addition: $2+3=3+2$ Example for multiplication: $3\times 5=5\times 3$
Distributive Property	When a single complex multiplication is split into several simpler multiplications to produce the same result. Example: $3\times(20+6)=(3\times 20)+(3\times 6)$

SUBTRACTION

Comparison Subtraction	A comparison relationship that involves two distinct sets or quantities and the difference between them. Example: You have 8 stickers and your friend has 3 stickers. How many more stickers do you have than you friend? In solving this problem, using the comparison subtraction strategy, use 8 counters in one set and 3 counters in another set. Match the counters from the two sets using one-to-one correspondence. The number of the counters that cannot be matched is the answer to the problem.  Answer: I have 5 more stickers than my friend.
Difference	The number which results when one number is subtracted from another. Example: $5-2=3$; 5 is the minuend, 2 is the subtrahend and 3 is the difference.

- **Minuend**

The number from which another number is to be subtracted.

Example: $5-2=3$; 5 is the minuend, 2 is the subtrahend and 3 is the difference.

- **Missing Addend**

An alternate model for subtraction that shows a missing part but not "take-away" action.

Example: You have 5 marbles. A friend gives you some more marbles and then you have 9 marbles. How many marbles did your friend give to you?

Students may solve this missing addend problem in two ways: (1) subtract the part (5 marbles) from the whole (9 marbles) to obtain the answer. (2) count forward from 5 marbles to determine how many marbles are needed to make the group of 9 marbles.

$5+\square=9$

Answer: My friend gave me 4 marbles.

Note: Students are not advised to use counting on with larger numbers.

Trailing Zeros

Zeros at the end of numbers that are multiples of 10.

Example: 30 and 50 each have one trailing zero. 1 700 has two trailing zeros.

Working Backwards

A strategy used to solve a problem in which you are given the answer and asked to find a piece of information. The sequence of actions starts with the problem solution and ends with the problem statement.

Example: Lori is given a collection of comics. She buys seven new ones, gives one-half of her comic collection to her friend and then has eight comics left. How many comics are in the collection Lori is given?

In using the working backwards strategy to solve this problem, reverse the order in which the conditions are given and start with the last condition—eight comics left. Double the eight to obtain 16 comics, i.e., the number of comics before sharing with the friend. Then subtract the 7 new comics to obtain the answer to the problem.

Answer: There are 9 comics in the collection Lori is given.

Algorithm

A standard method of performing a certain type of arithmetic operation, particularly a method that continually repeats some basic process.

Example: 15 ÷ 3

15
−③
12
−③
9
−③
6
−③
3
−③
0

There are five 3's; 15 ÷ 3 = 5.

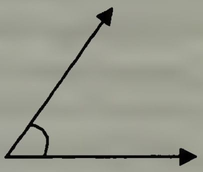
Analog Clock

A traditional clock with minute and hour hands.

ANGLES

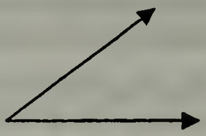
- **Angle**

  Two rays extending from the same end point.



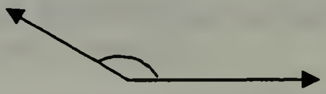
- **Acute Angle**

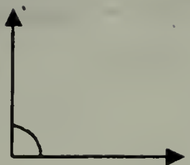
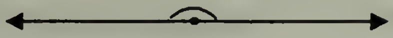
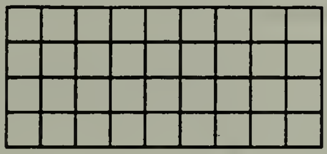
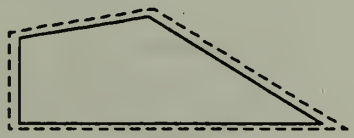
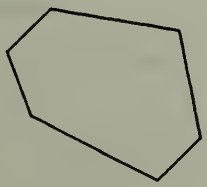
  An angle that measures less than 90°

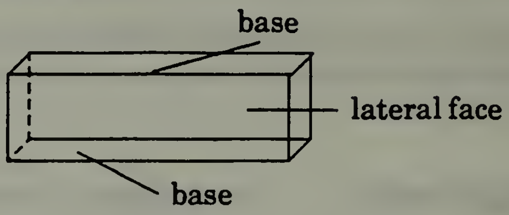


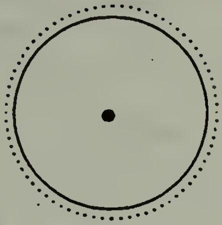
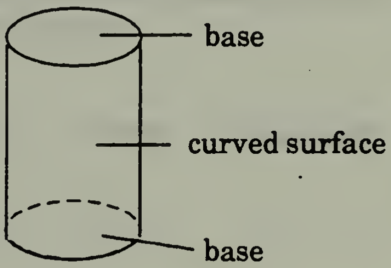
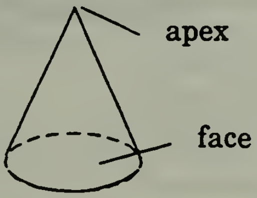
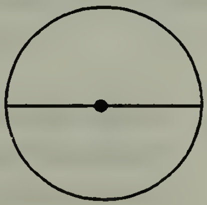
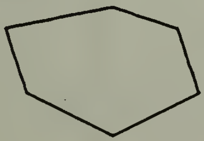
- **Obtuse Angle**

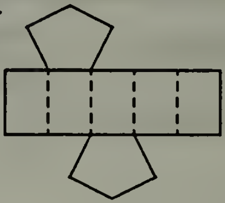
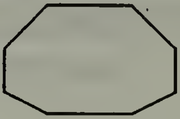
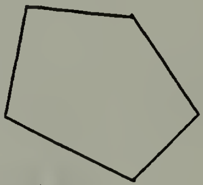
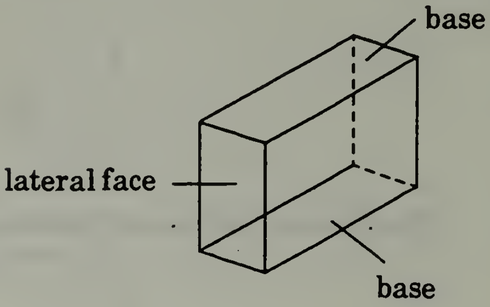
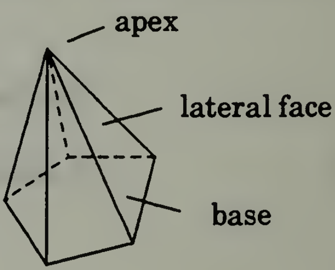
  An angle that measures more than 90° but less than 180°.

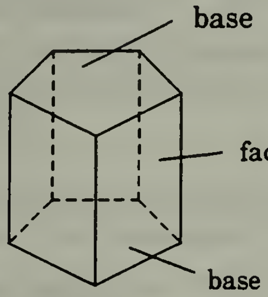
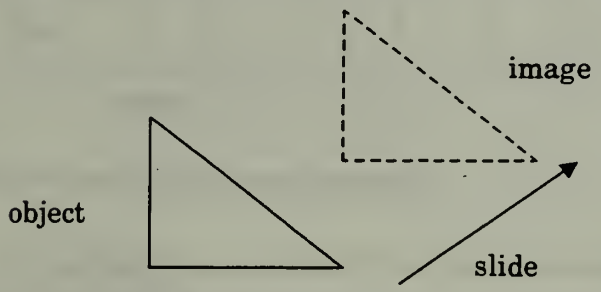
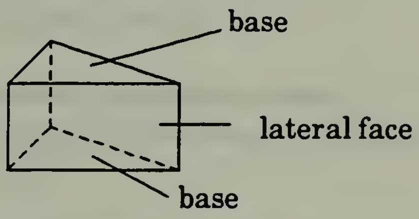
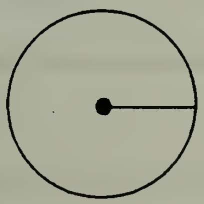
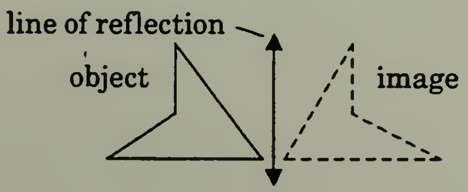


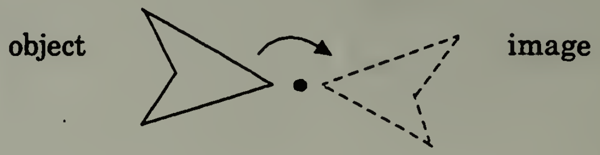
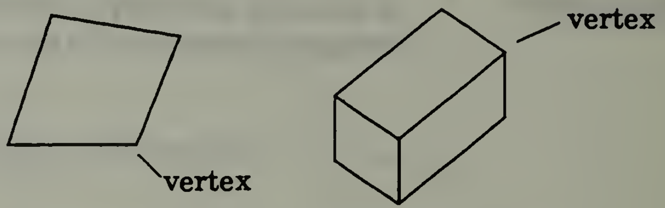
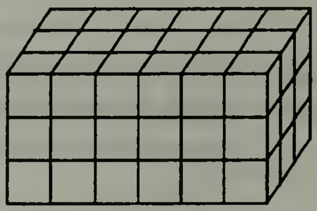
• **Right Angle**	An angle that measures 90°. 
• **Straight Angle**	An angle that measures 180°. 
Area	The number of unit squares needed to cover a region. 
Digital Clock	A clock that displays the time in numbers.
Mass	The quantity of material in an object. Mass is measured in grams, kilograms or tonnes, using a scale balance.
Non-standard Unit of Measure	A specified amount that is used repeatedly to indicate the length, capacity, mass, area or volume of objects. Example: Paperclips of uniform length could be used to measure the length of one's foot and to express the length in terms of paperclips.
Perimeter	The distance around a closed figure. 
Polygon	A closed figure with three or more sides 

Rectangular Prism (right)	A polyhedron that has two rectangles as bases and four rectangles as lateral faces. 
Standard Unit of Measure	The unit ordinarily used to indicate the length (mm, cm, dm, m, km), capacity (mL, L, kL), mass (g, kg, t), area or volume of objects.

Circumference	The distance around a circle. 
Cylinder	A three-dimensional object that has two congruent circular bases and one curved surface. 
Cone	A three-dimensional object made up of one circular face and one curved surface that comes to a point called the apex. 
Diameter	The distance across a circle measured through the centre. 
Edge	The line segment or curve where two surfaces meet.
Hexagon	A polygon with six sides. 

Net	A pattern for a polyhedron obtain by cutting the polyhedron along some edges and laying it flat. 
Octagon	A polygon with eight sides 
Pentagon	A polygon with five sides. 
Prism (right)	A polyhedron (all faces are polygons) that has two congruent and parallel bases and rectangles for its lateral faces. 
Pyramid	A polyhedron (polygon faces) that has one base (polygon) and the lateral faces are all triangles. The triangles meet at a vertex called the apex. 

Polyhedron	A three-dimensional object that has polygons as its faces. 
Translation (Slide)	A motion in geometry in which each point in an object is moved the same distance and in the same direction. 
Triangular Prims (right)	A polyhedron that has two triangles as bases and three rectangles as lateral faces. 
Radius	The distance from the centre of a circle to any point on the circumference of the circle. 
Reflection (flip)	A motion in geometry that forms a mirror image. The object and the image are equidistant from the line of reflection. 

Rotation (turn)	A motion in geometry in which an image is formed by turning an object about a fixed point called the turn centre. 
Vertex	A common end point of two sides of a polygon, or three or more edges of a three-dimensional object. 
Volume	The number of unit cubes needed to fill an object. 

DATA MANAGEMENT

Class Intervals	A method of grouping numerical information; e.g., the ages of students may be grouped into the class intervals of 5–9 years, 10–14 years, 15–19 years.
Concrete/Object Graph	A method of recording, organizing and displaying data by placing objects onto a mat with appropriate labels.

Example: In deciding the likelihood of a coin landing head up the students could make a concrete graph by placing each coin as it is flipped in the appropriate square on the mat.

heads							
tails							

DATA

• **Data**	Information (often numerical) that may be obtained first hand or second hand.
• **Experimental Data**	Data obtained by carrying out an experiment.
• **First-hand Information**	Data that people collect on their own by counting objects, conducting polls, conducting experiments or using measuring devices.
• **Poll/Survey**	A method of collecting data by asking people to give their answers to a given set of questions.
• **Second-hand Information**	Data that is obtained from sources such as encyclopedias, newspapers or reference books.
• **Theoretical Data**	Data obtained by reasoning and not by conducting experiments.

EVENTS	
• **Event**	One or more outcomes of a probability experiment; e.g., in flipping a coin twice, an event would be getting one of each on two flips; i.e,. H T or T H.
• **Certain Event**	An event that is sure to happen; e.g., in flipping a coin once, a certain event would be getting either a head or a tail.
• **Impossible Event**	An event that cannot happen; e.g., in flipping a coin once, an impossible event would be getting both a head and a tail.
• **Uncertain Event**	An event that may or may not happen; e.g., in flipping a coin once, an uncertain event would be getting a head.
• **Equally Likely Events**	Events that have the same probability or the same likelihood of happening; e.g., in flipping a coin once, getting a head or getting a tail is equally likely.
• **Frequency**	The number of times an event occurs.
Experiment	A situation in which a person or group carries out an activity from which data is obtained; e.g., a probability experiment may consist of flipping a coin several times to obtain the number of the heads and the number of tails.
Graphing	Producing a diagram that relates one set of data to another set of data.
Ordered Pairs	A set with two members, for which one member is designated as the first and the other as the second. In the first quadrant, both numbers in ordered pairs are positive. Example: (2, 6) and (6, 2) are different ordered pairs of numbers and represent different points.
Outcome	A result of a probability experiment; e.g., in flipping a coin once, an outcome would be getting a head.

PROBABILITY

- **Probability** The branch of mathematics concerned with analyzing the chance that a particular event will occur. It is the mathematics used to predict outcomes.

- **Probability of an Event** $\frac{\text{the total number of favourable outcomes}}{\text{total number of outcomes}}$; e.g., the probability of getting a head when flipping a coin once is $\frac{1}{2}$.

- **Theoretical Probability** Probability that is determined on the basis of reasoning, not through experimentation; e.g., in flipping a coin once, the probability of getting a head is determined by comparing the number of favourable outcomes (H) to the total number of possible outcomes (H,T); e.g., $\frac{1}{2}$

- **Experimental Probability** Probability that is determined on the basis of the results of an experiment; e.g., by tossing a paper cup a given number of times, one can use the information from this experiment to determine the probability that this cup will land on its side when tossed.

Rank Ordering Listing the data (numbers) from smallest to largest or from largest to smallest.

Stem-and-Leaf- Plot A chart used to record, organize and display numerical data in such a way that the original data remains intact, e.g., a stem-and-leaf plot could be used to record, organize and display the heights (in cm) of players on a basketball team.

Stem	Leaf
15	6, 8, 9
16	1, 2, 5, 5, 8, 8, 9
17	1, 2, 5, 7
18	1

Stem 15 added to leaf 6 equals 156 cm. Stem 15 added to leaf 9 equals 159 cm.

Tally A method of recording data that consists of short strokes grouped in fives; e.g., the tally 𝍸 || represents 7 items.

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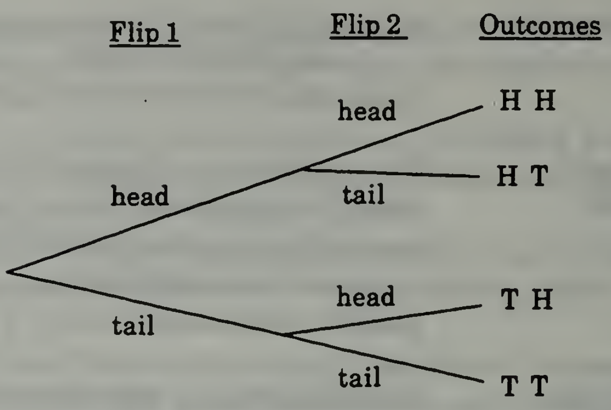
Tree Diagram

A systematic way for determining all the possible outcomes in a probability experiment or a counting context; e.g., a tree diagram could be used in determining all the possible outcomes in flipping a coin twice.



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